VOL.5 NO. 22
November 30, 1980

Energy Research Abstracts

ABSTRACTS 34461-35861

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications are regularly issued which are comprehensive in their coverage of certain energy fields. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

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Fusion Energy Update

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Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

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Vol. 5, No. 22
ISSN: 0160-3604
CODEN: ERABDZ
Nov. 30, 1980

ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

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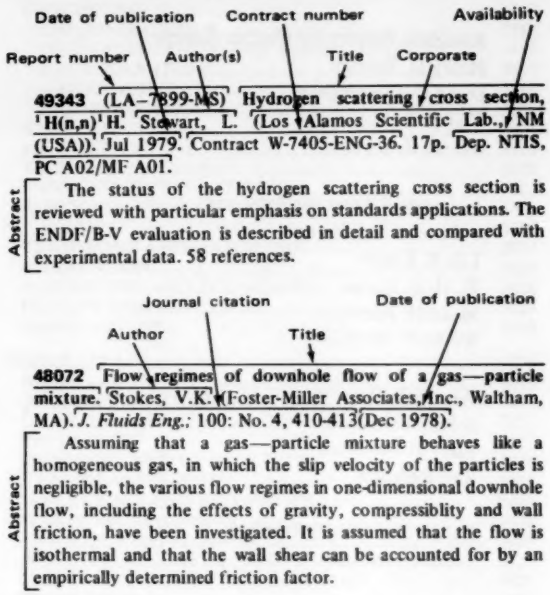
Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.
Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	**California Univ., Livermore (USA). Lawrence Livermore Lab.**	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	**4:49343**	**Dep. NTIS, PC A02/MF A01**
LA-tr-		
78-69	**4:48158**	**Dep. NTIS, PC A03/MF A01**

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

34461 (ORNL—5658) **Fossil energy program. Quarterly progress report for period ending March 31, 1980.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 440p. NTIS, PC A19/MF A01.

This quarterly report covers the progress made during the period December 31, 1979 through March 31, 1980 for the Oak Ridge National Laboratory research and development projects that are carried out in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. These projects are supported by the DOE Divisions of Fossil Fuel Processing, Fossil Fuel Utilization, Fossil Fuel Extraction, Planning and Systems Engineering, Basic Energy Sciences, Office of Health and Environmental Research, Office of Environmental Compliance and Overview, and by the Tennessee Valley Authority and the EPA Office of Research and Development through interagency agreements with the DOE.

34462 (ORNL/TM—7414) **Fossil energy program. Progress report for May 1980.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 128p. NTIS, PC A07/MF A01.

This report - the seventieth of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, chemical research and development, materials technology, component and process evaluation studies, technical support to major liquefaction projects, process analysis and engineering evaluations, fossil energy environmental analysis, coal preparation and waste utilization, coal preparation plant automation, technical support to the TVA fluidized bed combustion demonstration plant program, coal cogeneration/district heating plant assessment, atmospheric fluidized bed coal combustor for cogeneration, performance assurance system support and international energy technology assessment.

34463 (ORNL/TM—7444) **Fossil energy program. Progress report for June 1980.** McNeese, L.E. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 108p. NTIS, PC A06/MF A01.

This report - the seventy-first of a series - is a compendium of monthly progress reports for the ORNL research and development programs that are in support of the increased utilization of coal and other fossil fuel alternatives to oil and gas as sources of clean energy. The projects reported this month include those for coal conversion development, chemical research and development, materials technology, component and process evaluation studies, technical support to major liquefaction projects, process analysis and engineering evaluation, fossil energy environmental analysis, coal preparation and waste utilization, coal preparation plant automation, atmospheric fluidized bed coal combustor for cogeneration, TVA fluidized combustion demonstration plant program technical support, coal cogeneration/district heating plant assessment, performance assurance system support, and international energy technology assessment.

34464 **Final report on selected research projects leading to the development of Utah coal, tar sands and oil shale.** Salt Lake City, UT; University of Utah (1978). 204p.

This final report represents an important intital step in the long-range planning process necessary to more fully assure the orderly and economic development of Utah's fossil fuel resources. Basic purposes of this research program are: to provide information pertinent to the development of energy resources in the state of Utah; to improve the technology and economics of resource recovery; to identify the industrial chemical potential of resources; to explore other commercial uses of resources; and to develop energy research of mutual interest to the state of Utah and the University of Utah for the purpose of soliciting additional larger-scale funding from external sources. To achieve these objectives, five research projects were initiated and the following selected conclusions have resulted: Uinta tar sands bitumen exhibits characteristics equivalent to a premium grade asphalt. Current economic trends indicate that tar sands bitumen or bitumen products could become an economical petrochemical feedstock. Solution Mining of Utah Coal study results show a high probability for technical feasibility and further efforts to determine its technical and economic feasibility are recommended. The relatively high solubility of Utah oil shales greatly enhances its in-situ recovery potential. The operation of the adiabatic oil shale retort should indicate the optimum operating conditions for modified in-situ retorts to eliminate non-uniform gas flare and maximize recovery. A further, detailed analysis of oil shales will be necessary in order to determine if microwave processing techniques will prove worthy of development. A significant data base has been produced that has resulted (and is resulting) in the research team competing effectively for additional external funding.

PROCESSING

REFER ALSO TO CITATION(S) 35215

CARBONIZATION

REFER ALSO TO CITATION(S) 34514, 34523, 34524

34465 (DOE/EIA—0120/77) **Coke and coal chemicals in 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 7 Mar 1979. 34p. NTIS, PC A03/MF A01.

Data are presented on: production of oven coke, beehive coke, breeze and coal chemicals; quantity, origin, characteristics and value of coal carbonized; and sales and transfer of coke, breeze and coal chemicals to affiliated operations.

34466 (DOE/EIA—0120(78)) **Coke and coal chemicals in 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 23 Nov 1979. 27p. NTIS, PC A03/MF A01.

Data are presented on: quantity, characteristics, origin and value of coal carbonized; quantity of coke, breeze and coal-chemical material produced; quantity and value of coke, breeze and coal-chemical materials used or sold; quantity of coke and breeze distributed; and quantity of coke, breeze and coal-chemical material stocks.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 34506, 35239

34467 (PB—80-108467) **Hot gas cleanup process. Final report, January 1977-March 1979.** Onursal, A.B. (Dynalectron Corp., Bethesda, MD (USA). Applied Research Div.). Jul 1979. Contract EPA-68-02-2601. 155p. NTIS, PC A08/MF A01.

The report gives results of a study to identify and classify 22 hot gas cleanup (HGC) processes for desulfurizing reducing gases at above 430 C according to absorbent type into groups employing solid, molten salt, and molten metal absorbents. It describes each process in terms of its status, chemistry, operating characteristics, problems, and uncertainties. It assesses the applicability of none HGC processes to a variety of coal gasification systems for several end uses for the product gases. It evaluates advantages and disadvantages of HGC relative to conventional low temperature cleanup

systems with respect to thermal efficiency, the presence and/or emissions of tars, particulates, and NOx, and corrosion. It also presents economic comparisons between HGC and low temperature desulfurization. HGC processes are best suited for combined-cycle and on-site combustion applications coupled with low- or intermediate-Btu gasifiers. The Kennecott and MERC processes are applicable for desulfurizing gases at high temperatures. HGC processes provide greater overall efficiencies than low temperature desulfurization. Processing gases at high temperatures result in increased NOx emissions. Particulate removal at high temperatures is inefficient and corrosion problems increase. HGC processes complicate and add uncertainties which economically offset some thermal efficiency.

HYDROGENATION

34468 (DOE/ET/14881—2) **Mechanisms and kinetics of coal hydrogenation. Progress report, January-June 1980.** Gary, J.H.; Baldwin, R.M.; Bain, R.L. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). Jul 1980. Contract AC01-79ET14881. 37p. NTIS, PC A03/MF A01.

The objective of this task is to utilize the continuous-flow bench-scale coal liquefaction reactor system at CSM to investigate the rate of reaction of different coals at different processing conditions. Particularly, reaction rates at short residence times are to be measured in a Continuous Flow Stirred Tank Reactor (CSTR), and this information used to model reactions in the Plug Flow Reactor (PFR) section of the unit. Work during the past 6 months has focused on completing modifications to the unit itself, as the bench-scale system was originally designed to be operated at residence times just under 30 minutes. The new residence times are to be, at the least, just less than 6 minutes. The experimental portion will be a comparative study of the effect of different processing conditions on the rate of coal liquefaction. During the past six months, work on the continuous unit has been confined to modifications and system tune-up.

34469 (PB—80-108400) **Coke quench tower emission testing program. Final report, October 1977-December 1978.** Laube, A.H.; Drummond, B.A. (York Research Corp., Stamford, CT (USA)). Apr 1979. Contract EPA-68-02-2819. 160p. NTIS, PC A08/MF A01.

The report gives results of a field study to further define quench tower organic emissions, the character and magnitude of which are virtually unknown. (Limited testing in 1976 indicated that a large quantity of organic material was emitted from quench towers, but these data were inconclusive because so few samples were analyzed.) Sufficient stack samples were taken under controlled coke and quench water quality conditions to provide a statistically confident basis for emission factor determination. The samples were subjected to extensive organic chemical analysis for identification and quantification of similar functional groups and selected individual compounds known or expected to be carcinogenic. Fifty-three organic compounds were found in quench tower emissions; seven in sufficient quantity to be considered potential health hazards. The use of waste water from other coke plant sources for quenching greatly increases the organic load when compared to quenching with river water. Although the water itself is the principal source of organic emissions, the coke also appears to contribute. The majority of organics detected are either gaseous or associated with small particles, so they will contribute to ambient air loads beyond plant boundaries.

GASIFICATION

REFER ALSO TO CITATION(S) 34491, 34504, 34505, 34884

34470 (DOE/METC/SP—80/19) **In-service performance results for a 10-inch CVD-tungsten coated lockhopper valve seat.** Gardner, J.F. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). 28 Jul 1980. 17p. NTIS, PC A02/MF A01.

This report deals with in-service performance results of one 10-inch CVD-tungsten coated lockhopper valve seat produced by the Rolla Metallurgy Research Center of the US Bureau of Mines, Rolla, Missouri. This valve trim was produced under an interagency agreement between the Department of Energy and the US Bureau of Mines. The purpose of this agreement was to investigate the feasibility of hardfacing the critical sealing surfaces of solids handling valves and other devices by Chemical Vapor Deposition (CVD) in order to increase the wear resistance of these components for use in the severe service applications found in advanced coal conversion and utilization processes. Specifically, the results of in-service testing and evaluation of one 10-inch CVD-tungsten coated valve seat on the Morgantown Energy Technology Center, 42-inch stirred fixed-bed gasifier are presented. The use of CVD-tungsten as a seal surface in lockhopper valve applications was determined to be feasible under the process conditions to which it was subjected. Little or no significant wear other than a lapping effect was noted on the seal surface after 1,230 cycles of operation in a coal gasifier application.

34471 (DOE/PR/06010—T1) **Materials research for the clean utilization of coal. Quarterly progress report, January-March 1980.** (National Bureau of Standards, Washington, DC (USA). Center for Materials Science). 1980. Contract AI01-76PR06010. 51p. NTIS, PC A04/MF A01.

An interpretive report, summarizing erosive wear failures in coal conversion pilot plants was completed, reviewed by DOE and submitted for NBS editorial review. The Failure Information Center transmitted 198 abstracts and 8 hard-copy reports to industry. Compressive yield measurement of MHD refractories at 1400°C, 1500°C, and 1580°C are presented for loading at 0.0002 in/min. The electrical conductivity of $YCrO_3$ doped with five percent Ca has been measured in a highly reducing atmosphere at temperatures from 1300 to 1600°C. Several polarization experiments have been completed using slag (Bow, New Hampshire) as an electrolyte and using platinum electrodes. The electrical conductivity of a Bow, New Hampshire, slag sample containing an added amount of iron has been measured. At low temperatures (1200°C) the conductivity increased nearly proportional to the added iron but at higher temperatures (above 1350°C) the conductivity increased by a factor of five when the iron content was doubled. Type 316 stainless steel tubes, cooled to 400°C, 500°C, and 590°C, were exposed to oxygen-rich hot gas streams seeded with K_2SO_4. Optical SEM, and EDX analysis indicate the geometric and chemical nature of the deposits and reaction zones to be similar to those of Type 304 stainless steel exposed previously under the same conditions.

34472 (EPRI-AP—1422(Vol.1)) **Entrained gasification combined-cycle control study. Volume 1. Summary of results and conclusions.** Clark, J.; Denton, L.; Hashemi, M.; Joiner, J.; Smelser, S.; Chowaniec, C.; Hobbs, M.; Jennings, S.; Phelts, E. (Fluor Engineers and Constructors, Inc., Irvine, CA (USA); Westinghouse Electric Corp., Concordville, PA (USA)). Jun 1980. 119p. NTIS, PC A06/MF A01.

In this study, two control strategies were evaluated for an entrained coal gasifier fueling a gas turbine/steam turbine combined-cycle power plant forming an integrated plant which was simulated by computer to analyze alternative control strategies. Transient operation of this gasification-combined-cycle (GCC) plant was studied to determine open-loop response as a stand-alone plant, as well as closed-loop response while functioning in a typical utility power system. GCC plant performance during specified operating contingencies such as equipment trip or emergency shutdown, was also studied. Conclusions may be summarized as follows: The GCC plant may be controlled satisfactorily in either gasifier-lead or turbine-lead control mode. The absorber column consistently removed 90% of the hydrogen sulfide (H_2S) in the raw fuel gas produced from high sulfur Illinois coal during the closed loop control runs. GCC plant pressure control must be installed to minimize plant pressure transients of the absorber column in the Acid Gas Removal Unit. The local controllers adequately maintained the GCC plant operation during all the emergency upsets examined. The GCC plant responds well to typical variations in electric power demand, i.e., gradual changes for daily load following and successive rapid changes for the tie-line thermal backup and frequency regulation. Supplemental fuel gas storage is not required. The design and operating characteristics of the oxygen plant can affect the response time of the GCC plant. A separate study of oxygen plant design alternatives is recommended to evaluate potential improvements in transient response rate and turndown capability, since the specific tradeoffs between process economics and more flexible dynamic operation are not clear. Ultimately, the effects of the oxygen plant response upon fuel gas composition during typical GCC plant load changes should be examined.

34473 (FE—1514-117) **Advanced coal gasification system for electric power generation. Second quarterly progress report FY 1980, January 1-March 31, 1980.** (Westinghouse Electric Corp., Madison, PA (USA). Advanced Coal Conversion Dept.). 25 Apr 1980. Contract AC01-76ET10161. 63p. NTIS, PC A04/MF A01.

During 1979, two air-blown shakedown tests with the two-stage integrated system, five single-stage oxygen-blown gasifier tests and two single-stage air-blown gasifier tests were conducted in the PDU, accumulating 1044 hours of hot operation. The results of these tests were reviewed with regard to performance and requirements for commercial application. The economic viability for commercial use of the Westinghouse oxygen-blown system relates to its low usage of steam relative to other processes (on the order of 0.2 to 0.6 pounds of steam per pound of coal depending on the coal type). Typical results of the oxygen-blown tests are presented and compared with commercial predictions made through the use of Westinghouse's various mathematical models. The PDU measured methane content of 2.2 percent represents that which correlations predict would exist at 130 psig. The application of the methane correlation to the commercial plant yields an 8.4 percent methane content as a result of higher pressure, low heat losses and reduced

recycle gas and carbon dioxide inputs. Tests planned for 1980 will continue to follow the previous testing philosophy and include operability tests, process evaluation tests and process demonstration tests. Eight single-stage tests are planned, seven oxygen-blown and one air-blown. In conjunction with the test program, major PDU construction and installation modifications will be performed to support subsequent tests.

34474 (FE—2012-096(Sect.2)) **Pipeline gas demonstration plant. Phase I. Process evaluation report, conceptual commercial plant. Section 2. Process analysis: commercial plant concept.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). May 1980. Contract AC01-77ET13031. 113p. NTIS, PC A06/MF A01.

The Commercial Plant consists of three parallel trains for the main processing areas. Multiple trains of smaller equipment offer operating flexibility that a single larger train cannot. For a plant of this magnitude, economic, technical feasibility, and operational flexibility factors favor the multiple train configuration. The COGAS gasifier-combustor system with recirculating char may be compared with two typical processes practiced commercially in the petroleum industry. The commercial analog for the combustor is a vertical slagging cyclone combustor used in utility boilers. The pyrolysis scheme used in the COGAS Process is based on the development work and operating experience gained in the FMC Formcoke Plant and the COED Pilot Plant. The major feature of pyrolysis, as practiced in these two plants, is avoidance of oxidation and agglomeration. Avoidance of oxidation maximizes the oil yield and improves oil quality. Pyrolysis temperature is increased stagewise to avoid agglomeration and renders the fluidized beds operable.

34475 (FE—2012-096(Sect.3)) **Pipeline gas demonstration plant. Phase I. Abbreviated version of process evaluation report, conceptual commercial plant. Section 3. Process design studies.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). May 1980. Contract AC01-77ET13031. 193p. NTIS, PC A09/MF A01.

This Process Evaluation Report (PER) contains the results and recommendations of comprehensive analyses and studies which were made to optimize the ICGG Commercial Plant Baseline Process Concept for producing synthetic pipeline gas (SPG) from coal. Design studies to optimize the thermal efficiency and economic attractiveness of the COGAS Process Areas of the plant were conducted along with design studies and trade-off studies of available process subsystems to complement the COGAS Process Areas. The results, recommendations and description of the work accomplished in developing the PER are contained in six separately bound sections. Section 3 describes various design studies which were conducted to optimize the COGAS Process Areas and other plant areas.

34476 (FE—2012-096(Sect.5)) **Pipeline Gas Demonstration Plant: Phase I. Abbreviated version of process evaluation report, conceptual commercial plant. Section 5. Baseline process concept, Book 1.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). May 1980. Contract AC01-77ET13031. 367p. NTIS, PC A16/MF A01.

This Process Evaluation Report (PER) contains the results and recommendations of comprehensive analyses and studies which were made to optimize the ICGG Commercial Plant Baseline Process Concept for producing synthetic pipelines gas (SPG) from coal. Design studies to optimize the thermal efficiency and economic attractiveness of the COGAS Process Areas of the plant were conducted along with design studies and trade-off studies of available process subsystems to complement the COGAS Process Areas. The results, recommendations and description of the work accomplished in developing the PER are contained in six separately bound sections. Section 5 describes the ICGG Commercial Plant Baseline Process Concept which was developed from the Tentative Baseline Design (TBD) and was used as a standard for measuring the results of the Process Design Studies and Trade-off Studies.

34477 (FE—2012-096(Sect.6)) **Pipeline gas demonstration plant. Phase I. Abbreviated version of process evaluation report conceptual commercial plant. Section 6. Baseline economic evaluation.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). May 1980. Contract AC01-77FT13031. 56p. NTIS, PC A04/MF A01.

The Commercial Plant capital requirement is estimated at $1,550,602,000. These costs are all expressed in year end-1977 dollars. The operating cost for the Commercial Plant is based on a 20 year plant design life, operating for 330 days per year (90.4% plant effectiveness) with an overall thermal efficiency of 62.4%. The total operating cost as defined, is $157,017,409 per year. The Commercial Plant gas cost is computed on the net present value analysis basis using the revenue requirement method. A discount rate of 9% is used in the calculation. The revenue requirement method determines the lowest gas selling price per MM Btu which will recover all costs incurred during the twenty-five year project life. The selling price in year end 1977 dollars is $4.597 per MM Btu. Various factors used in the calculation are given in some detail.

34478 (FE—2355-39(Rev.N/C)) **Lockhopper Valve Type I, II and IV P/N 75895, S/N 3. Failure analysis report.** (Consolidated Controls Corp., El Segundo, CA (USA)). Aug 1980. Contract AC01-76ET10669. 20p. NTIS, PC A02/MF A01.

This report covers the analysis of a failure which occurred during testing of a Type I, II and IV Lockhopper Valve P/N 75895. The unit was assembled and tested at Consolidated Controls Corporation, El Segundo, California.

34479 (FE—2679-T1) **Gasification Combined Cycle Test Facility. Final report.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Sep 1979. Contract EF-77-C-01-2679. 427p. NTIS, PC A19/MF A01.

This report describes the project scope, goals and status of the engineering and development work (at project termination) for the Gasification Combined Cycle Test Facility, a joint effort by the US Department of Energy, the Electric Power Research Institute, Commonwealth Edison Company, and the State of Illinois to couple a gasifier producing low Btu gas to a gas turbine/combined cycle system for generating electric power. Among other objectives, this plant was to test an integrated system of this type for its ability to respond to the demands of an electric power grid. The processes intended for use included two Lurgi fixed bed gasifiers, a hot potassium carbonate desulfurization system, a Stretford sulfur removal system and a General Electric Frame 5 Gas Turbine/Generator. Plant erection was intended for Pekin, Illinois, at Commonwealth Edison's Powerton Station. The gasifiers were to consume 20 tons/hr of coal. Design coal for the plant was Illinois No. 6, a high sulfur coal. The test program included Eastern caking and Western noncaking coals of varying heating values. There were several design features which received special attention. A dynamic computer simulation was being prepared which would have helped predict plant operational problems and equipment failures. The combustor development work was being done by General Electric to ensure stable combustion of the lower heating value gases. Because of the corrosion problems associated with a plant of this type, substantial emphasis was placed on metallurgy. These topics are discussed in detail. The project was terminated on December 21, 1978 at the convenience of the Department of Energy.

34480 (UCRL—50026-80-1) **LLL in situ Coal Gasification Project. Quarterly progress report, January-March 1980.** Olness, D.U. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 May 1980. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01.

We have performed three small-scale, coal-block reactor experiments in order to gain some insight into the performance of the proposed injection well design for the next field test, and to better understand some of the observed in situ phenomena which occurred during the Hoe Creek No. 3 field test. The modeling group has begun to consolidate into a single data base the data from Hoe Creek No. 1, No. 2, and No. 3, permitting some comparisons which are presented and discussed. During and after the Hoe Creek experiments, groundwater samples were collected from wells located at a distance of a few feet to several hundred feet from the gasification cavities. Analysis of the water was performed and work is continuing to understand and to explain the observed increased concentration of several cations. Several sources of information, including two recent papers by Zvyaghintsev covering Soviet UCG stations, have been analyzed. The Soviets developed an effective method for UCG in the 1950's. Plans were developed to increase UCG production from 0.7 billion m^3 in 1958 to over 40 billion m^3/yr. These plans were not implemented; production peaked in 1966 at 2 billion m^3/yr and declined to 0.7 billion m^3/yr by 1977. The reasons for this decline are presumed to be the poorer heating values, closer wellbore spacings, and higher product gas losses at Angren than expected. Comparable results would produce unfavorable economics in the US. Also, UCG technology in the USSR faced stiff competition from natural gas production and efficient open-pit coal mining.

34481 **Corrosion, sulfidation resistance: a prime target.** *Mater. Compon. Newsl.;* No. 28, 1-4(1 Jun 1980).

Metals performance inside gasifier reactors or in off-gas locations seemed most dependent upon the process itself. Relatively benign conditions such as those found in the CONOCO COAL, HYGAS, and SYNTHANE gasifier reactors may preclude the need for exotic alloys, clads and/or coatings. More aggressive high-temperature evironments may require avoidance of internal piping/valving in scale-up designs. In most every plant studied, low chromium, nickel-base alloys such as those represented by INCONEL 600 and MONEL 400 performed erratically. Even though such materials may not be specified for components, they invariably appear as weldments, often causing problems in the initial material selection sought to avoid. In quench and purification sections of the pilot plants studied, austenitic stainless steels performed very well. Where high temperatures (800+ F) are not involved, the low carbon variants are advisable to minimize the possibility of stress corrosoion cracking due to the presence of liquid phases either incident to normal operation or resulting from condensate during off-line peri-

ods. Although stress corrosion cracking was not observed in prestressed specimens, it has been reported at several of the same pilot plant locations in which the MPC exposures were made.

34482 Process for removing slag during pressure gasification of solid fuels. Rudolph, P. (to Metallgesellschaft Aktiengesellschaft). US Patent 4,180,387. 25 Dec 1979. Priority date 30 Aug 1977, German, Federal Republic of (F.R. Germany), 6p.

In the gasification of granular solid fossil fuel in a reactor wherein the fuel forms a fixed bed moving from top to bottom of the reactor under gravity, oxygen-containing gases and water vapor are fed into the fuel bed through nozzles in the lower portion of the reactor, molten slag at a temperature of about 1350 to 1500°C is discharged through a conduit which is inclined to the horizontal, and product gas is withdrawn from the reactor above the fuel bed. Oxygen gas is fed into the reactor adjacent to the inlet of the slag discharge conduit and directed from above onto the molten slag, thereby forming a leakage gas at a temperature of at least about 1500°C. This leakage gas is withdrawn through the slag discharge conduit co-current with the slag. The leakage gas is separated from the slag in a lock chamber and mixed with the product gas. The temperature and/or composition of the leakage gas in the slag discharge conduit may be used to control the rate at which leakage is produced. A corresponding apparatus is described. This simplifies slag discharge and prevents clogging.

34483 Activity and sulfur tolerance studies of molybdenum based methanation catalysts. Bartholomew, C.H.; Fowler, R.W. Jr. (Brigham Young Univ., Provo, UT). pp 213-218 of Chemistry and uses of molybdenum. Barry, H.F.; Mitchell, P.C.H. (eds.). Ann Arbor, MI; Climax Molybdenum Company (1979).

From 3. international conference on the chemistry and uses of molybdenum; Ann Arbor, MI, USA (19 Aug 1979).

Molybdenum containing catalysts were tested for specific methanation activity and resistance to poisoning by hydrogen sulfide. Catalysts included: molybdenum/alumina, nickel-copper-molybdenum/alumina, three preparations of nickel-molybdenum on alumina and two preparations of nickel-molybdenum/silica-alumina. Alumina supported nickel was tested for comparison. Tests included hydrogen chemisorption measurements, measurements of specific rate at 140 kPa, 498 to 523°K and deactivation tests over 1 to 3 days with 10 ppM hydrogen sulfide in the reactant mixture. Results of the in situ deactivation measurements confirm the strong and irreversible nature of sulfur-metal interactions resulting in relatively rapid, substantial poisoning of methanation catalysts. Nickel-molybdenum catalysts evidence the same or greater methanation activity and improved sulfur tolerance compared to nickel.

34484 Preparation and activity of nickel-molybdenum methanation catalysts. Wilhelm, F.C.; Tsigdinos, G.A.; Ference, R.A. pp 219-223 of Chemistry and uses of molybdenum. Barry, H.F.; Mitchell, P.C.H. (eds.). Ann Arbor, MI; Climax Molybdenum Company (1979).

From 3. international conference on the chemistry and uses of molybdenum; Ann Arbor, MI, USA (19 Aug 1979).

Nickel-molybdenum methanation catalysts were prepared by impregnation of various supports with a $Ni(NO_3)_2$-$(NH_4)_6Mo_7O_{24}$-H_2O_2 solution. Loadings as high as 20 wt % Mo and 13 wt % Ni were obtained using this method. Supports evaluated included γ-Al_2O_3, Y-Zeolite, 87 wt % SiO_2-13 wt % γ-Al_2O_3 and 94 wt % γ-Al_2O_3-6 wt % SiO_2. Methanation activity was determined at 1.5 and 7.0 MPa (200 and 1000 psig), 427 to 593°C (800 to 1100°F), 3000 h^{-1} GHSV using a feed gas containing 20% CO, 20% CH_4 and 60% H_2. Best results were obtained with the 94 wt % γ-Al_2O_3-6 wt % SiO_2 and γ-Al_2O_3 supports. A slow, stepwise reduction of the catalysts in hydrogen gave the highest initial and long-term activity (to 800 h). Preliminary data indicate an increase in shift activity when 14 ppM COS was added to the feed gas.

LIQUEFACTION

REFER ALSO TO CITATION(S) 34468, 34471, 34527, 34528

34485 (DOE/ET/13397—T1) Studies in coal liquefaction with application to the SRC and related processes. Quarterly report, November-January 1978. Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1978. Contract AC01-79ET13397. 122p. NTIS, PC A06/MF A01.

Screening experiments with model sulfur, nitrogen, and oxygen compounds were first undertaken to determine the relative ease of breaking down C-N, C-O, and C-S bonds to remove heteroatoms in the presence of various coal mineral catalysts. Iron, pyrite, and SRC residue ash showed moderate catalytic activity. All the reactions were conducted in a small tubing-bomb reactor under coal liquefaction conditions. The importance of mass transfer in the hydrogenation reaction was observed, especially in the presence of active catalysts. In addition, a detailed analysis of the controlling regimes in the hydrodesulfurization (HDS) of benzothiophene over pyrite catalyst in a slurry reactor was made. The primary product of benzothiophene HDS with pyrite was 2,3-dihydrobenzothiophene, but with pyrrhotite the selectivity shifted toward ethylbenzene. Also, the HDS of benzothiophene was influenced greatly by mass transfer effects as evidenced by changes in the reaction rate as a function of agitation speed, pyrite particle size, and a low activation energy above 385°C.

34486 (DOE/ET/14503—2) Development of a correlation between slurry oil composition and process performance. Topical report 2. Analyses of slurry recycle oils from H-Coal PDU Run 8. Burke, F.P.; Winschel, R.A.; Pochapsky, T.C. (Conoco Coal Development Co., Library, PA (USA). Research Div.). Aug 1980. Contract AC05-79ET14503. 38p. NTIS, PC A03/MF A01.

Daily samples of the slurry recycle oils from H-Coal PDU Run 8 (Illinois 6 coal, Fuel Oil and Interdediate modes) were analyzed by ^{1}H-NMR spectroscopy, GC/MS, and liquid chromatographic techniques. The residual recycle material (975°F$^+$, THF soluble) is much higher in preasphaltenes than corresponding material from the Syncrude mode with the same coal. This may have caused, or been caused by operability problems in PDU 8, many of which involved plugging at various points in the PDU. In any case, the combination of high preasphaltenes and operability problems can combine to significantly accelerate catalyst deactivation. Because of these factors, and the segmented nature of PDU Run 8 it is not possible to make any statement regarding the attainment of steady-state in either the Fuel Oil or Intermediate modes.

34487 (DOE/EV/10291—T1) Indirect liquefaction of coal. (International Research and Technology Corp., McLean, VA (USA)). 30 Jun 1980. Contract AC01-79EV10291. 47p. NTIS, PC A03/MF A01.

The most important potential environmental problems uniquely associated with indirect liquefaction appear to be related to the protection of occupational personnel from the toxic and carcinogenic properties of process and waste stream constituents, the potential public health risks from process products, by-products and emissions and the management of potentially hazardous solid wastes. The seriousness of these potential problems is related partially to the severity of potential effects (i.e., human mortality and morbidity), but even more to the uncertainty regarding: (1) the probable chemical characteristics and quantities of process and waste streams; and (2) the effectiveness and efficiencies of control technologies not yet tested on a commercial scale. Based upon current information, it is highly improbable that these potential problems will actually be manifested or pose serious constraints to the development of indirect liquefaction technologies, although their potential severity warrants continued research and evaluation. The siting of indirect liquefaction facilities may be significantly affected by existing federal, state and local regulatory requirements. The possibility of future changes in environmental regulations also represents an area of uncertainty that may develop into constraints for the deployment of indirect liquefaction processes. Out of 20 environmental issues identified as likely candidates for future regulatory action, 13 were reported to have the potential to impact significantly the commercialization of coal synfuel technologies. These issues are listed.

34488 (DOE/PC/30072—T1) Studies of the mechanism of Coal Hydrogenation by Electron Spin Resonance. Quarterly technical progress report, March 1-May 31, 1980. Goldberg, I.B. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Jul 1980. Contract AC22-80PC30072. 26p. NTIS, PC A03/MF A01.

This is the first quarterly report on the program Studies of Coal Hydrogenation by Electron Spin Resonance. This quarter has been devoted to constructing apparatus for high temperature-high pressure electron paramagnetic resonance (EPP) measurements, characterizing the performance of the microwave cavity, and carrying out preliminary room temperature studies on coals and coal products. At the start of this program, there were no microwave cavities available to study high pressure-high temperature reactions. A system was constructed which can be used to study coal hydrogenation, and satisfies the conditions described in the report. This cavity was constructed using funding from Rockwell International, and will be used on this program. Because of the dependence of the work to be done with this device for this program, the construction is described in detail. This report, therefore, considers the design philosophy, construction of the device, a preliminary discussion of its performance, and application of the cavity for room temperature studies on several varieties of coal.

34489 (IS-M—282) Pressure vessels for coal liquefaction: an overview. Scott, T.E. . (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 37p. (CONF-8005108—1). NTIS, PC A03/MF A01.

From ASTM symposium on the application of 2 1/4 cr-1 mo steel for thick wall pressure vessels; Denver, CO, USA (18 May 1980).

The existing world economic and political climate has intensified the need for a domestic source of liquid fuels. With dwindling crude oil reserves the need for alternate sources of liquid fuels has

become pressing. Coal-derived liquids can be an important substitute for crude oil. A key component of process plants designed to liquefy coals is the reactor. Coal liquefaction pressure vessels (reactors) for anticipated commercial operations are large by conventional standards. They must maintain a high level of reliability for lifetimes from 20 to 30 years while operating at temperatures near 800°F (425°C) and while containing a variety of sulfurous species and hydrogen at pressures up to about 4000 psi (28 MPa). This paper attempts to emphasize the role of reactors in the coal liquefaction process and to point out potential life-limiting aspects which must be considered in the design, construction, and operation of these large, thick-walled pressure vessels.

34490 (PB—80-108566) **Engineering evaluation of control technology for H-coal and Exxon donor solvent processes. Final report, January 1977-March 1979.** Sarna, K.R.; O'Leary, D.T. (Dynalectron Corp., Bethesda, MD (USA). Applied Research Div.). Jul 1979. Contract EPA-68-02-2601. 125p. NTIS, PC A06/MF A01.

The report gives results of an evaluation of the control technology of two coal liquefaction processes, H-Coal and Exxon Donor Solvent. The effluent streams were characterized and quantified for both processes and plants (pilot and conceptualized commercial). The gaseous-, liquid-, and solid-stream emissions were analyzed for their controllability, process complexity, and efficiency. Extrapolations to the larger commercial size were based partly on pilot plant data and (where such data was unavailable) engineering judgment. Several information gaps were encountered for liquid and solid effluent streams, especially as to composition. These deficiencies were pointed out and recommendations were outlined. Present control technology for the H-Coal process seems to be barely adequate: present designs are inadequate for zero discharge criteria. Control technology for the EDS process depends on being able to rely on the facilities of an adjacent refinery's controls: the scalability of present control technologies, especially in the case of the bag filter operation, is not confirmed.

34491 **Method for hydrogenation of coal.** Sinor, J.E. (to Cameron Engineers, Inc.). US Patent 4,180,452. 25 Dec 1979. Filed date 22 Aug 1977. 6p.

A process for hydrogenating coal to produce benzene and other gas and liquid products comprises saturating the pulverized and dried coal with methanol. The methanol saturated coal is slurryed in benzene, and the slurry is exposed to microwave energy of a frequency and for a period of time sufficient to effect hydrogenation of the coal. The benzene liquid effects an immediate quench, and the hydrogenation products are collected and separated. The principal product of the hydrogenation is benzene. Unreacted coal and char may be recycled or subjected to gasification with steam and oxygen to produce synthesis gas which can be converted to methanol.

34492 **Upgrading of coal liquids.** Zaczapinski, S.; Kamienski, P.W.; Toups, H.J.; Smith, R.S.; Turner, D.W. (Exxon Res and Eng Co, Baytown, Tex). *Proc., Am. Pet. Inst., Refin. Dept.;* **58**: 373-379(1979). (CONF-7905163—).

From 44. American Petroleum Institute refining department midyear meeting; San Francisco, CA, USA (14 May 1979).

It is concluded that the current reforming/hydrotreating technology can accommodate coal-derived liquids from the EDS (Exxon Donor Solvent) liquefaction process. This is especially true with the primary EDS products, which are 350 F-minus naphtha and 350 F-plus fuel oil. The naphtha represents an excellent reformer feedstock and generates considerable yield of hydrogen, which can be recycled in the process or can be used for upgrading other product streams. The fuel oil can be altered in composition by process configurations or can be upgraded by hydrotreating. Should fuel oil hydrotreating become the preferred option, additional data will be required to define the preferred conditions for catalyst activity maintenance and improved operability. 5 refs.

34493 **Refining the products from the src coal liquefaction process.** Sullivan, R.F.; Stangeland, B.E.; Frumkin, H.A. (Chevron Res Co, Richmond, Calif). *Proc., Am. Pet. Inst., Refin. Dept.;* **58**: 387-400(1979). (CONF-7905163—).

From 44. American Petroleum Institute refining department midyear meeting; San Francisco, CA, USA (14 May 1979).

SRC-I and SRC-II are two versions of the Solvent-Refined Coal Liquefaction process under development by the Pittsburgh and Midway Coal Mining Company in programs funded by the Department of Energy (DOE). The primary products from these processes have sharply contrasting characteristics. SRC-I product is a high melting solid that is a relatively unattractive feed for conversion to distillate fuels using petroleum hydroprocessing technology. In constrast, the SRC-II product is a distillate that is a more attractive feed for conversion to transportation fuels. Essentially all of the nitrogen, sulfur, and oxygen can be removed in a single, catalytic hydrotreating stage to yield a naphtha that is an excellent feed for a catalytic reformer and a middle distillate fraction that is a premium jet fuel, meeting smoke point and stability specifications. 25 refs.

34494 **Refining coal liquids.** Fant, B.T. (Exxon Research and Engineering Co., Baytown, TX); Barton, W.J. pp 224-230 of 1978 proceedings: Refining Department. Volume 57. Washington, DC; American Petroleum Institute (1978).

From 43. American Petroleum Institute midyear meeting; Toronto, Canada (8 May 1978).

Product quality research is a key element in the overall development program of the Exxon Donor Solvent (EDS) process. This presentation will summarize the significant findings to date in this product quality research effort. Specifically, the presentation will compare the EDS coal liquids with petroleum stocks and will project the most likely initial market outlets for these materials. Problem areas will be identified and potential solutions to these problems will be discussed. In particular, the role of hydrotreating as a primary upgrading step will be explored.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 34465, 34466, 34620

34495 **Characterization of a complex mixture of aromatic and heterocyclic acids obtained from oxidation of lignite coal and its solvent-refined products.** Duty, R.C.; Hayatsu, R.; Scott, R.G.; Moore, L.P.; Winans, R.E.; Studier, M.H. (Argonne Natl Lab, Ill). *Fuel;* **59**: No. 2, 97-101(Feb 1980).

This study reports the results from the oxidation, using sodium dichromate, of a solvent-refined lignite (SRL) and its feed coal and the effects of varying the ratio of oxidant to coal. The numerous aromatic and heteroaromatic carboxylic acids isolated were identified as their methyl esters. Oxidation of solvent-refined lignite yielded a large number of polycyclic aromatic and heteroaromatic acid. 18 refs.

PROPERTIES

REFER ALSO TO CITATION(S) 34514

34496 (DOE/BETC/RI—80/1) **Composition of liquids from coals of different rank.** Sturm, G.P. Jr.; Thomson, J.S.; Woodward, P.W.; Vogh, J.W. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Sep 1980. 48p. NTIS, PC A03/MF A01.

Eight coal liquids prepared from six coals of widely differing rank were compared with respect to their suitability as potential feedstocks for production of refined fuels. The compositions of the liquids were determined by methods adapted from those developed for characterization of petroleum crudes. The coal liquids were prepared and upgraded by hydrogenation in a batch autoclave. The reaction conditions employed were selected to minimize hydrocarbon ring-opening reactions and, at the same time, to produce most of the hydrocarbon liquids potentially available from the coals. The degree of hydrogenation of the raw coal liquids was varied as required to decrease the nitrogen content to about the same level and to provide a predominantly hydrocarbon liquid for analysis. Distilled fractions of the upgraded coal liquids boiling up to 540°C were characterized by a combination of separation and analytical techniques including adsorption chromatography; gel permeation chromatography; separations of acids, bases, and asphaltenes; and high- and low-resolution mass spectrometry. In general, the results show that liquids of comparable suitability as feedstocks for production of refined fuels can be produced from coals of different rank.

34497 **Forms of sulfur in east Texas lignite coal.** Arora, H.S.; Pugh, C.E.; Hossner, L.R.; Dixon, J.B. (Pacific Northwest Lab., Richland, WA). Contract W-7405-ENG-26. *J. Environ. Qual.;* **9**: No. 3, 383-386(Jul 1980).

Distribution of sulfur and its three predominant forms in 10 lignitic coal seams developed in fluvial environments in east Texas was examined. The average sulfur content for individual seams varied from 0.88 to 3.98%, while the total sulfur content of 10-cm sections of these seams varied from 0.53 to 16.79%. Sulfate sulfur was a minor component compared to pyritic or organic sulfur. The organic sulfur content determined by the standard American Society for Testing and Materials (ASTM) procedure as the difference between the inorganic sulfur (sulfate + pyritic sulfur) and the total sulfur in the original material, in general, remained uniform within a given lignite profile. A significant correlation was obtained between the organic sulfur content obtained by the ASTM procedure and a more direct method of density separation of specific gravity < 1.6 fraction and the determination of total sulfur in this fraction with an induction furnace and automatic titrator. Pyritic sulfur had the most variable distribution with a greater concentration of pyrite occuring at the seam fringes, which suggests the need for separate handling of these high-pyrite content mine spoils for safe disposal.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 35454

34498 (FE—3269-17A) **Design, construction, operation and evaluation of a Prototype Culm Combustion Boiler/Heater Unit. Quarterly technical progress report, April 1-June 30, 1979.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Sep 1979. Contract ET-78-C-01-3269. 49p. (CW-WR—036-17). NTIS, PC A03/MF A01.

This report provides a summary of the work performed on the Prototype Culm Combustion Boiler/Heater Unit, Phase I - Engineering Design and Analysis during the period April 1, 1979 through June 30, 1979. The objectives of the program as well as the technical progress and problem areas encountered during the reporting period are presented. Progress on the components and system engineering studies is described. Combustion studies effort has been completed. Environmental investigation in the area of air quality, noise and liquid and solid waste effluent disposal is described herein. Final design activity has been initiated and the progress on drawing preparation and advanced procurement activity is discussed.

34499 (FE—3269-22A) **Design, construction, operation and evaluation of a Prototype Culm Combustion Boiler/Heater Unit. Technical progress report, July 1-September 30, 1979.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Jan 1980. Contract AC01-78ET12307. 77p. (CW-WR—036.22A). NTIS, PC A05/MF A01.

This report provides a summary of the work performed on the Prototype Culm Combustion Boiler/Heater Unit, Phase I - Engineering Design and Analysis. The objectives of the program as well as the technical progress and problem areas encountered are presented. Progress on the components and system engineering studies is described. The Technical and Economic Evaluation of the Prototype and Larger Size Facility Topical Report was prepared and submitted. The Preliminary Design of Prototype Unit Topical Report has been prepared and is in publication preparatory to submittal. Environmental investigation in the area of air quality, noise and liquid and solid waste effluent disposal was completed and the Site Evaluation and Socio-Economic Impact Topical Report was submitted. Final design activity is in progress and the progress on drawing preparation and advanced procurement activity is discussed.

34500 (FE—3269-24A) **Design, construction, operation and evaluation of a Prototype Culm Combustion Boiler/Heater Unit. Quarterly technical progress report, October 1-December 31, 1979.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Feb 1980. Contract AC01-78ET12307. 23p. (CW-WR—78-036.24A). NTIS, PC A02/MF A01.

This report provides a summary of the work performed on the Prototype Culm Combustion Boiler/Heater Unit, Phase I - Engineering Design and Analysis and Limited Phase II - Prototype Plant Construction during the period October 1, 1979 through December 31, 1979. The objectives of the program as well as the technical progress and problem areas encountered during the reporting period are presented. Progress on the components and system engineering studies is described. The Preliminary Design of Prototype Unit Topical Report was submitted during this reporting period. Final design activity is continuing and the progress on drawing preparation and advanced procurement activity is discussed. Based on authorization for a limited amount of Phase II activity, initial purchase orders were released authorizing preparation of certified drawings for fabricated equipment required to support the Phase I final design activity. The Purchase Order for site clearance and installation of boiler foundations was awarded during this reporting period and ground breaking ceremonies were held at the Prototype Culm Combustion Boiler site in Paxinos, Pennsylvania on December 7, 1979.

34501 (FE—3269-25A) **Design, construction, operation and evaluation of a Prototype Culm Combustion Boiler/Heater Unit. Quarterly technical progress report, January 1-March 31, 1980.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Apr 1980. Contract AC01-78ET12307. 69p. (CW-WR—78-036-25A). NTIS, PC A04/MF A01.

This report provides a summary of the work performed on the Prototype Culm Combustion Boiler/Heater Unit, Phase I - Engineering Design and Analysis and Phase II - Prototype Plant Construction during the period January 1, 1980 through March 31, 1980. The objectives of the program as well as the technical progress and problem areas encountered during the reporting period are presented. Final design activity is continuing and the progress on drawing preparation and procurement activity is discussed. Based on authorization for a limited amount of Phase II activity on November 2, 1980, purchase orders were released authorizing preparation of certified drawings for fabricated equipment required to support the Phase I final design activity and based on full Phase II authorization on March 20, 1980, procurement of fabricated equipment was initiated. Vendor drawings submitted in support of the final design activity are discussed. The prototype plant site has been cleared and leveled, and boiler concrete foundations have been poured. Stone roadways are scheduled for completion by April 30, 1980.

34502 (PB—80-126477) **Coal conversion control technology. Volume II. Gaseous emissions; solid wastes. Final report, April 1977-November 1978.** Bostwick, L.E.; Smith, M.R.; Moore, D.O.; Webber, D.K. (Pullman Kellogg, Houston, TX (USA)). Oct 1979. Contract EPA-68-02-2198. 384p. NTIS, PC A17/MF A01.

This volume is the product of an information-gathering effort relating to coal conversion process streams. Available and developing control technology has been evaluated in view of the requirements of present and proposed federal, state, regional, and international environmental standards. The study indicates that it appears possible to evolve technology to reduce each component of each process stream to an environmentally acceptable level. It also indicates that such an approach would be costly and difficult to execute. Because all coal conversion processes are net users of water, liquid effluents need be treated only for recycling within the process, thus achieving essentially zero discharge. With available technology, gaseous emissions can be controlled to meet present environmental standards, particulates can be controlled or eliminated, and disposal of solid wastes can be managed to avoid deleterious environmental effects. This volume (II) deals with the control technology of gaseous emissions and solid wastes.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 34467, 34469, 34487, 34490, 34502, 34532, 34887, 35393, 35394, 35395, 35396, 35397, 35398, 35481, 35482, 35483, 35484, 35485, 35486, 35490, 35491, 35492

34503 (JPL-PUB—79-82) **Methodology for the environmental assessment of advanced coal extraction systems.** Sullivan, P.J.; Hutchinson, C.F.; Makihara, J.; Evensizer, J. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jun 1980. Contract AI01-76ET12548. 205p. NTIS, PC A10/MF A01.

This document describes the methodology which was developed to identify and assess potential environmental impacts of advanced mining technology as it moves from a generic concept to a more precise systems definition. Two levels of assessment are defined in terms of the design stage of the technology being evaluated. The first level of analysis is appropriate to a conceptual design. At this level it is assumed that each mining process has known and potential environmental impacts that are generic to each mining activity. By using this assumption, potential environmental impacts can be identified for new mining systems. When two or more systems have been assessed, they can be evaluated by comparing potential environmental impacts. At the preliminary stage of design, a systems performance can be assessed again with more precision. At this level of systems definition, potential environmental impacts can be analyzed and their significance determined in a manner to facilitate comparisons between systems. An important output of each level of analysis is suggestions calculated to help the designer mitigate potentially harmful impacts.

34504 (PB—80-108251) **Summary of gas stream control technology for major pollutants in raw industrial fuel gas. Final report, July 1977-March 1979.** Hoffert, F.D.; Soung, W.Y.; Stover, S.E. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Jul 1979. Contract EPA-68-02-2601. 163p. NTIS, PC A08/MF A01.

The report summarizes coal gasification and clean-up technology with emphasis on methods of producing a clean industrial fuel gas as defined by agreement for study purposes. The coal-derived industrial fuel discussed produces no more than 0.5 lb of SO2, 0.4 lb of NOx, and 0.1 lb of particulates per million Btu of fuel gas. In general, existing state-of-the-art control technology will allow these emission guidelines to be met, although the end use for the fuel gas will strongly influence the choice of the pollution control technology that is used. Many but not all important factors pertinent to control technology application were considered. Costs are an example of important factors which were not evaluated because the objective was to first determine appropriate technology that could be applied. Emissions other than the three major pollutants indicated were given only cursory treatment. Nevertheless, a general overall background of control technology for industrial fuel gas has been covered.

34505 (PB—80-108392) **Control technologies for particulate and tar emissions from coal converters.** Chen, C.; Koralek, C.; Breitstein, L. (Dynalectron Corp., Bethesda, MD (USA). Applied Research Div.). Jul 1979. Contract EPA-68-02-2601. 115p. NTIS, PC A06/MF A01.

The report gives results of a characterization of solid and tar particulate emissions in raw product gases from several types of coal

gasifiers, in terms of their total quantities, chemical composition, and size distribution. Fixed-bed gasifiers produce the smallest particulate loadings, about 3 g/cu m. Entrained-bed gasifiers produce the largest, about 110 g/cu m. Control technologies for particulate emissions were assessed with respect to the limitations of the control device and to existing and proposed regulations. Fabric filters were not suitable where tar particulates were found or at higher than 300 C. Electrostatic precipitators operated as high as 1100 C. Rotary cyclones showed the widest range of applicability. Conventional cyclones were most economical for particles larger than 50 microns. Solid and tar particulate emissions collected for 250,000 scfd of a medium-Btu gas contained up to 1.6 million kg of particulate containing about 400 ppM of organic compounds which were benezene extractable. Naphthalenes and three-ring aromatic compounds each showed compositions of about 15 ppM. More than a dozen other classes of compounds were identified in the analyses of the organic material deposited on the particulate matter.

34506 (PB—80-108954) **Applicability of coke plant control technologies to coal conversion. Final report, August 1977-March 1979.** Hossain, S.M.; Cilione, P.F.; Cherry, A.B.; Wasylenko, W.J. Jr. (Catalytic, Inc., Philadelphia, PA (USA)). Aug 1979. Contract EPA-68-02-2167. 214p. NTIS, PC A10/MF A01.

The report gives results of comparisons of process and waste stream characteristics from the Byproduct coke over process with selected gasification and liquefaction processes. It includes recommendations regarding control technologies for air, water, and solid wastes. Coke oven control technology was reviewed extensively. State and Federal regulations for the disposal and treatment of coke oven wastes are presented, along with a brief assessment of health effects attributed to coke oven emissions. Study results indicate that a number of coke oven control technologies are applicable to coal conversion systems, especially those dealing with desulfurization, fugitive emissions, byproduct recovery/upgrading, and wastewater treatment. Byproduct upgrading and fugitive emission control technologies may be readily transferable to analogous coal conversion applications. Desulfurization and wastewater treatment technologies, however, cannot be transferred readily to applications where significant differences exist in the composition, temperature, and pressure of the two categories of process/waste streams. In these cases, laboratory or pilot plant scale tests will be required with actual coal conversion wastes to determine the design bases and the treatability variations between coal conversion and comparable coke oven streams.

34507 (PB—80-111677) **Computer processing of multispectral scanner data over coal strip mines. Final report, 1 January 1978-30 June 1978.** Tanner, C.E. (Lockheed Electronics Co., Inc., Las Vegas, NV (USA). Remote Sensing Lab.). Mar 1979. Contract EPA-68-03-2636. 62p. NTIS, PC A04/MF A01.

There is little doubt that remote sensing techniques can be effectively applied to the task of monitoring coal strip mine progress and reclamation work. Aircraft multispectral scanner data acquired over six coal strip mines in the states of Wyoming, Montana, Colorado, and Arizona were processed on the Data Analysis System (DAS) using a clustering approach to automatic pattern recognition. The classification results demonstrated that a Level I hierarchy of vegetation features, manmade features, and disturbed areas could be easily obtained with a minimum amount of time. Aside from satisfying a Level I hierarchy, the results may be used as input to other classification approaches to pattern recognition, or they may be incorporated into a data base for planning or for conducting temporal analyses studies.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 34508, 34520

MINING

REFER ALSO TO CITATION(S) 34503, 34520, 34533, 35147

34508 (DOE/EIA—0064(80)) **Coal data: a reference.** Slatick, E.R. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1980. 60p. NTIS, PC A04/MF A01.

34509 (DOE/EIA—0126(77)) **Energy data report: distribution of Pennsylvania anthracite for the calendar year 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Apr 1979. 11p. NTIS, PC A02/MF A01.

This report of the Department of Energy presents detailed and summarized data on the distribution of Pennsylvania anthracite in 1977, by size of output from preparation plants and method of transportation. Shipments of Pennsylvania anthracite totaled 5,801,603 short tons in calendar year 1977, a decline of approximately 5% from the amount shipped in 1976. Shipments to markets within the United States totaled 4,743,259 tons or almost 82% of total shipments. Exports to the Canadian market totaled 525,638 short tons in 1977, an increase of 18% over the 445,397 tons exported in 1976. The carrier method of anthracite shipments was approximately 63% by truck and 37% by rail.

34510 (DOE/ET/12501—T1) **Dragline bucket improvement survey. Final report, September 30, 1977-September 29, 1979.** Stilwell, T.; Kelly, H.; Rumbarger, J.; Dowling, M. (Franklin Research Center, Philadelphia, PA (USA)). 1979. Contract AC01-77ET12501. 92p. NTIS, PC A05/MF A01.

An operating dragline bucket receives a lot of abuse. It logs about a million dig cycles every two or three years, all the while operating through abrasive overburden on a round-the-clock basis. It is to the credit of designers, operators and maintenance men alike that these buckets perform so well under such adverse conditions. Comments made in this report are for the purpose of focusing on areas in which further improvements can be made, and in no way are intended to reflect adversely on the generally high quality of bucket design, use and repair. From December 1977 to September 1978, investigators visited nine surface coal mines to review first-hand the techniques and problems associated with dragline equipment. The contractor also conducted some basic analyses regarding bucket geometry and force patterns. The report concludes that: dragline bucket and rigging designs, while traditionally satisfactory, could be bettered in some areas; the major maintenance problem associated with buckets and associated rigging is abrasive wear; the repair costs for associated rigging (primarily chains) can run in excess of 50% of the repair costs for buckets; there is no established engineering information available regarding stresses, forces, soil flow and soil resistance in relation to dragline buckets; present computer monitoring and analysis equipment could, with appropriate modifications, be utilized to yield useful engineering information.

34511 (DOE/ET/12502—1(Vol.1)) **Dragline roller track improvement. Volume I. Evaluation of low hardness dragline track materials in rolling contact. Final report, September 30, 1976-July 30, 1980.** Dunfee, J.; Leonard, L.; Rumbarger, J. (Franklin Research Center, Philadelphia, PA (USA)). 1980. Contract AC01-76ET12502. 142p. NTIS, PC A07/MF A01.

The Franklin Research Center (FRC), a Division of the Franklin Institute, was contracted by the Bureau of Mines to improve walking dragline roller tracks. The contract was subsequently transferred to the Department of Energy. The period from September 1977 to September 1978 covered laboratory rolling contact rig tests to evaluate typical low hardness dragline track materials. The results of this work are covered by DOE/ET/9121-1 Final Report, Volume I. The period from September 1978 to July 1980 covered field measurements of dragline roller circle loadings. The results of this work are covered by DOE/ET/9121-2 Final Report, Volume II. The laboratory rolling contact rig test results indicate that forged vacuum degassed air melt steel materials are recommended over air-melt cast materials for rollers and tracks. The steels tested exhibited good freedom from sensitivity to stress raisers like brinell marks and small holes or discontinuities (Volume I). The largest unknown in a recommended method for life testing roller tracks is the condition of the upper rotating frame structure and the lower tub supporting structure.

34512 (DOE/ET/12502—1(Vol.2)) **Dragline roller track improvement. Volume II. Field measurement of dragline roller circle loading. Final report, September 30, 1976-July 30, 1980.** Gambs, G.; Tuft, R.; Yankanich, J.; Rumbarger, J. (Franklin Research Center, Philadelphia, PA (USA)). 1980. Contract AC01-76ET12502. 48p. NTIS, PC A03/MF A01.

The period from September 1977 to September 1978 covered laboratory rolling contact rig tests to evaluate typical low hardness dragline track materials. The results of this work are covered by DOE/ET/9121-1 Final Report, Volume I. The period from September 1978 to July 1980 covered field measurements of dragline roller circle loadings. The results of this work are covered by DOE/ET/9121-2 Final Report, Volume II. During May 1979, a field test group visited the Beltona Mines in Warrior, Alabama, for the purpose of instrumenting and testing dragline roller circle loading. This testing was done both before and after the introduction of elastomeric padding between the upper track and rotating frame. The data collected indicates installation of an elastomeric pad between the rotation frame and the upper track reduced the strain in the upper track. The primary reason for these load and strain reductions was added flexibility provided by the elastomeric pad coupled with redistribution of local loads. Installation of the elastomeric pad also reduced the peak roller loads resulting from hard spots due to dragline construction. More field data is necessary to fully appreciate the positive and negative effects of elastomeric pad on roller track loading. This information can be obtained through more thorough testing and instrumentation program.

34513 (PB—80-110315) **Grouting horizontal drainage holes in coalbeds. Report of investigations 1979.** Aul, G.N.; Cervik, J. (Bureau of Mines, Reno, NV (USA). Reno Metallurgy Research Center). 1979. 22p. NTIS, PC A02/MF A01.

This report describes a method developed by the Bureau of Mines for sealing horizontal degasification holes so that they do not create a gas explosion hazard when intercepted by mining. A cement slurry is pumped into the hole through an injection pipe that extends to the back of the hole. Pumping continues until the slurry returns through the annulus to the hole collar. The hole is then shut in and the grout allowed to harden. Application of the procedure to six horizontal degasification holes at Eastern Associated Coal Corp.'s Honey Run shaft is discussed.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 34520, 34521, 34530

34514 (CONF-790770—2) **Peat dewatering and upgrading by the Koppelman process.** Phillips, R.C.; Murray, R.G.; Koppelman, E. (SRI International, Menlo Park, CA (USA). Chemical Engineering Lab.; Koppelman (Edward), Encino, CA (USA)). 1979. Contract AT03-76ET20064. 16p. NTIS, PC A02/MF A01.

From Management assessment of peat as an energy resource meeting; Arlington, VA, USA (22 Jul 1979).

The Koppelman process for irreversible drying and upgrading of low value fuels has been applied to peat from various sources. The paper describes an adaptation of the Koppelman process in which peat is hydraulically mined and pipelined as a slurry to a plant where it is converted to a high quality solid fuel, designated as K-Fuel. In the Koppelman process wet feedstocks are heated under pressure to achieve partial carbonization. Water and carbon dioxide are displaced and the product has a high heating value, typically 4000 to 5000 Btu/lb higher than the heating value of conventionally dried peat due to the removal of oxygen. K-Fuel made from peat has a heating value up to 14,000 Btu/lb, depending on ash content and severity of treatment. This fuel can be burned in a solid fuel-fired burner or can be ground and dispersed readily in fuel oil to burn as a slurry. Thermal pretreatment converts the peat to a form that can be partially dewatered by filtration. The dewatered peat is then conveyed through the reactor where it is heated further to partially carbonize the peat. The product is extruded from the reactor, then cooled and chopped into a convenient form. Water from the reactor can be treated by wet air oxidation to reduce the organic content and to generate the steam required by the process.

34515 (IS-M—284) **Selective magnetic enhancement of pyrite in coal by dielectric heating at 27 and 2450 MHz.** Bluhm, D.D.; Fanslow, G.E.; Beck-Montgomery, S.; Nelson, S.O. (Ames Lab., IA (USA); Georgia Univ., Athens (USA). Richard B. Russell Agricultural Research Center). 1980. Contract W-7405-ENG-82. 21p. (CONF-8006116—1). NTIS, PC A02/MF A01.

From Conference on chemistry and physics of coal utilization; Morgantown, WV, USA (4 Jun 1980).

The objective of this project is to improve the magnetic separation of coal and pyrite by enhancing the magnetic susceptibility of pyrite in run-of-mine (ROM) coal through the use of selective pretreatments such as dielectric heating and induction heating. Separation of pyrite from coal would be facilitated by changing a portion of each pyrite particle to a more magnetic form. The selective magnetic enhancement of pyrite in coal by dielectric heating was investigated fundamentally and experimentally. Fundamental treatment consisted of the measurement of the dielectric properties, at frequencies ranging from 1 MHz to 11.7 GHz, of a selection of coals and their pyritic fractions. These values were then used to calculate the theoretical heating that would be produced in these materials and their mixtures. The experimental treatment involved heating fractions and their mixtures at 27 and 2450 MHz. Results showed limited agreement between theoretical and experimental heating and that it is possible to selectively heat pyrite in coal. Preliminary data indicate an increase in the apparent mass susceptibility of dielectrically heated pyrite samples that is roughly proportional to the time and power of pretreatment. Magnetic separation tests are being started.

34516 **Update of lockhopper valve development.** Gardner, J.E.; Freeburn, F.D. *Chem. Eng. Prog.;* **76**: No. 2, 84-92(Feb 1980).

At the 'Morgantown' Energy Technology Center lockhopper valves for the injection of solids such as coal into high pressure reactor vessels, or for the removal of solids from such vessels, are being developed, and state of the art valves are veing tested to determine their suitability for use in coal conversion processes. Some test results are summarized.

34517 **Method and apparatus for controlled dewaterizing of coal treatment underflow.** Messer, L. (to American Minechem Corp.). US Patent 4,178,243. 11 Dec 1979. Filed date 15 Mar 1978. 12p.

A coal treatment underflow of an aqueous slurry of fine solid particles is dewaterized by first adding to the aqueous slurry a preferably high molecular weight flocculant lyophobic to water and lyophilic to fine solid particles to form a mixture. The mixture is charged to a thickener where flocculated solids are settled from the mixture and water separated from the mixture. During settling, the flocculated solids are preferably subjected to increased settling area and changing direction of liquid flow to increase the settling rate of the flocculated solids. A radiation beam is impinged on the flocculated solids transverse the direction of travel of the solids adjacent the discharge means from the thickener, and the impinged radiation beam is detected by detector means to continually measure the density of the flocculated solids preferably by degree of absorption of radiation. The detector in turn produces an electrical signal proportional to the density of the flocculated solids that automatically regulates and controls the rate of discharge of the flocculated solids from the thickener.

COMBUSTION

REFER ALSO TO CITATION(S) 34545, 34882, 35285

34518 (DOE/ER/10062—T1) **Assessment of the potential of colloidal fuels in future energy usage. Final report.** (Battelle Columbus Labs., OH (USA)). 25 Feb 1980. Contract AC01-79ER10062. 121p. NTIS, PC A06/MF A01.

Pulverized coal has been an increasing important source of energy over the past century. Most large utility boilers, all modern coking plants, and many industrial boilers and blast furnaces employ pulverized coal as a major feed stream. In periods of oil shortages, such as during World Wars I and II, the concept of adding powdered coal to oil for use in combustion equipment originally designed for oil has been actively pursued but rarely used. Over this same period of time, there have been attempts to use air suspensions of coal dust in diesel engines in Germany, and in turbines in various countries. The economic advantages to be enjoyed by substitution of powdered coal in oil are not generally realized. Oil costs at $30/bbl represent a fuel value of about $5.00/$10^6$ Btu; coal at $25/ton is equivalent to approximately $1.00/$10^6$ Btu. Although capital costs for the use of coal are higher than those associated with the use of oil, coal is clearly becoming the least costly fuel. Not only are considerable cost advantages possible, but an improvement in balance of payments and an increase in reliability of fuel supplies are other potential benefits. It is therefore recommended that increased national attention be given to develop these finer grinds of carbonaceous fuels to be used in various suspending fluids. Technical areas where significant additional support appear desirable are described.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 34465, 34466, 34477, 34494, 34509, 34518, 34531, 34533, 35474

34519 (ANL/EES-TM—95) **Method for analyzing the potential feasibility of coal brokerage operations.** Wilkie, K.; Vezeris, S. (Argonne National Lab., IL (USA); Northwestern Univ., Evanston, IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 104p. NTIS, PC A06/MF A01.

Thesis.

There is one major prerequisite for unit train service. High volumes of coal are needed to make the operation both practical and economical. Many existing or potential coal users are too small to directly benefit from the cost savings and reliability of unit train service. If the demand for coal by a number of small users in a region could be aggregated so that the resulting volume was high enough to justify a unit train service, the users of the region could well be served through a single unit train receiving facility. Thus, coal users individually too small to receive unit train shipments could capture cost savings associated with a larger volume operation. It is the intent of this thesis to study the feasibility of such an operation, hereafter referred to as a coal brokerage. The specific purpose is to develop and present an analytical framework for evaluating the long-run economic feasibility of a coal brokerage for a region. The analysis views the brokerage operator, or broker, as a firm, and focuses on the relationships between its long-run cost function and market demand function for coal.

34520 (CONF-7710236—) **Proceedings of the 29th Canadian conference on coal.** (Coal Association of Canada, Calgary, Alberta). 1977. 139p. NTIS (US Sales Only), PC A07/MF A01.

From 29. Canadian conference on coal; Edmonton, Alberta, Canada (2 Oct 1977).

The 29th Canadian Conference on coal was held at Edmonton, Alberta, Oct 2-4, 1977. Eight papers from the proceedings have

been entered individually into EDB and ERA. The papers deal with federal and provincial governement and energy policies, coal deposits (especially in the western provinces), exports to Japan, transportation systems, energy supplies and energy demand and competition to coal from other energy sources and from coal in other countries. (LTN)

34521 (CONF-7710236—, pp 83-86) **Role of transportation in Canada's international coal trade.** Kirkwood, D.H. (Transport Canada, Ottawa, Ontario). 1977.

From 29. Canadian conference on coal; Edmonton, Alberta, Canada (2 Oct 1977).

While a western tranport network was put in place long before the commencement and subsequent growth in the west of new coal mines serving Japan, the advent of large coal shipments, and the potential for large increases in the next two decades, have already caused significant changes in the transport system and will undoubtedly lead to further change. In direct terms, the development of coal led to the construction and operation of a very efficient unit-train/bulk terminal system, whose design and performance has so far fulfilled the needs of both shippers and carriers. However, the movement of increasing volumes of coal, combined with growth in other traffic aroused concern about the adequacy of western freight transport services. Two years ago it seemed that while some spare bulk terminal capacity existed it was difficult of access, and might not be able to satisfy the potential demand even to 1985. Furthermore the economic capacity of the rail mainlines serving Vancouver appeared at a limit, and it was thought that very large sums would be required to add the required increments to rail capacity. More recently, however, a deferral of market opportunities resulting from the worldwide slowdown has permitted some breathing space. Any approach to the role of transportation in the coal trade rests in large part on an assessment of future demand. The broad or strategic options for future coal-related transport development have been identified and as they are understood in Transport Canada are summarized in the text.

34522 (CRA—491) **Meaning and significance of seller concentration in the coal industry. Final report.** (Charles River Associates, Inc., Boston, MA (USA)). Mar 1980. Contract AC01-79EI10603. 93p. NTIS, PC A05/MF A01.

The principal conclusions and recommendations from the study by Charles River Associates of conceptual issues related to the measurement of seller concentration in the coal industry are summarized. In analyzing issues of market definition and concentration measures, we closely examined four recent government studies on concentration and competition in the coal industry. The level of seller concentration is a useful statistic for competitive analysis, but users should be aware of its limitations. The competitive assessment of an industry requires, in addition, that other elements of market structure and also market behavior be considered. Since coal usually trades in markets which are distinct from the markets for oil, gas, and nuclear fuel, properly defined coal markets constitute a meaningful entity for competitive analysis. Separate markets exist at present for high-grade bituminous metallurgical coal and for steam coal. The boundary lines of these markets are becoming less distinct, however, as electric utilities seek more low-sulfur coal and some low-rank butuminous coal is used in the production of coke. The market for metallurgical coal can be distinguished according to high or low volatility of the coal. Spot coal and contract coal trade in a single market, since their prices are closely interrelated by arbitrage. Metallurgical coal has two geographic markets: (1) the West; and (2) the East and Midwest. Within the latter, North and Central Appalachia emerges as a distinct submarket. Steam coal has three geographic markets: Appalachia, the Midwest, and the West. Some studies have further divided the West into the Northern Plains and Southwestern markets. Factors influencing competitive relationships are frequently changing in relevance and relative importance. Consequently the boundaries of each coal market are dynamic.

34523 (DOE/EIA—0122(78)) **Energy data reports: coke producers in the United States in 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 4 Sep 1979. 6p. NTIS, PC A02/MF A01.

This report continues the annual series on Coke Producers in the United States. Data was collected from those plants known to be operating on December 31, 1978, and was compiled from Bureau of Mines form 6-1370-A, and Department of Energy forms EIA-5 and EIA-5A. The coke industry of the United States on December 31, 1978, was composed of 63 plants: 18 classified as merchant and 45 as furnace. Furnace plants are those owned by iron and steel companies whose principal business is producing blast-furnace coke for their own use. Merchant plants are either associated with chemical companies of gas utilities, or operate to produce coke and coal-chemical materials for sales in the open-market. Newly included in the merchant plant classification are beehive coke plants and other nonrecoverable coke oven operators. In the only change of ownership that occurred during 1978 the Allied Chemical Corporation merchant plant at Buffalo, New York, was acquired by the Tonawanda Coke Company. Coke plants are listed alphabetically by state on the following pages. This list includes name and address of the company, plant name, classification (merchants or furnace) and major uses of coke and coal-chemical materials produced. An end-use is considered a major use if it is 20 percent or more of the plant's total disposal of coke. All plants except the beehive and nonrecovery ovens produced crude coal tar. Forty-five plants produced some type of ammonia product. Fifteen plants recovered intermediate light oil and forty-nine recovered crude light oil.

34524 (DOE/EIA—0123/77) **Energy data reports: distribution of oven and beehive coke and breeze in 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 10 Apr 1979. 25p. NTIS, PC A02/MF A01.

This report shows in detail the distribution of oven and beehive coke and breeze produced in the United States in 1977. It covers shipments from the 65 known coke producers operating all or part of 1977. The data presented pertain only to coke produced from coal in oven- and beehive-coke plants. Breeze is the term applied to the small sizes of coke that result from screening. It usually includes pieces of coke that will pass through a 1/2-inch screen, although larger sizes are sometimes included. The tables show the amount of coke produced and distributed by principal use, State, and geographic region. Because the tonnage of beehive coke is very small, (0.4 million tons in 1977), it is included with oven coke. The statistics for several States are combined in tables 3, 4, and 5 to avoid disclosing individual company confidential data. Exports are shown as reported by producers; foreign shipments by export firms and wholesalers are not included.

34525 (DOE/EIA—0123(78)) **Distribution of coke and breeze in 1978. Energy data reports.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 7 Dec 1979. 24p. NTIS, PC A02/MF A01.

This report presents data for 1978 submitted by US coke producers to the Energy Information Administration (EIA), US Department of Energy, on Bureau of Mines Form 6-1370-A/EIA Form 5A, Coke and Coal-Chemical Materials and EIA Form 5, Coke and Coal Chemical Materials (Monthly). Data presented includes distribution data for coke and breeze to consuming states, from producing states, and by end-use.

34526 (PB—80-116858) **Economics of the US metallurgical coal industry. Program working paper.** Spearman, J.E. (West Virginia Univ., Morgantown (USA). Dept. of Mineral Economics). Oct 1978. 280p. NTIS, PC A13/MF A01.

The report attempts to define the degree of jointness between metallurgical coals and steam coals, to separate production and long run capacities analytically, and to examine the independent performance of the metallurgical coal sector regionally. Implications are drawn concerning the adequacy and price of long run metallurgical coal supplies. Research results indicate that virtually all high-volatile coals have perfect substitutability between metallurgical and boiler uses.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 34487, 35399, 35597, 35598, 35599, 35600, 35601, 35602, 35603, 35604, 35610, 35615, 35617, 35618, 35619, 35620, 35621, 35622, 35623, 35624, 35625, 35630, 35631, 35633, 35634, 35635, 35636

34527 (FE—496-T23) **Solvent refined coal (SRC) process: health programs research and development report No. 53. Volume III. Pilot plant development work. Part 4. Industrial hygiene, clinical, and toxicological programs. Interim report No. 32, July 1, 1978 through December 31, 1979.** (Pittsburg and Midway Coal Mining Co., Englewood, CO (USA)). Aug 1980. Contract AC01-76ET10104. 142p. NTIS, PC A07/MF A01.

This report summarizes the Health Program under the Solvent Refined Coal (SRC) Process Contract from July 1, 1978 through December 31, 1979. The major areas of activity within the Health Program are: an industrial hygiene monitoring program, a clinical medical examination program, a personal hygiene and educational program, and a toxicological program. The industrial hygiene monitoring program during this period centered on the collection of airborne suspended particulates, organic vapors, and dustfall samples. Suspended particulates were generally higher during SRC-I operation as compared to SRC-II operation. Measurements of organic vapors indicated virtually negligible occupational exposures to n-hexane, benzene, toluene, and xylenes. No significant difference of plant dustfall levels were observed between SRC-I and SRC-II operation. The SRC industrial hygiene information retrieval system was utilized to provide statistical data on worker exposure in various areas of the pilot plant. An evaluation program was initiated on a skin wash procedure to measure skin contamination. The medical examination program continued to indicate the absence of discern-

ible occupationally related changes in employee medical profiles. Several additions and revisions have been made to the employee personal hygiene and educational program to improve effectiveness and promote better comprehension. A new toxicology program has been designed for the evaluation of materials from both the SRC-I and SRC-II processes. An Invitation for Bid was sent to a number of commercial laboratories qualified to perform such studies.

34528 Solvent refined coal : energy savior or health hazard. Shields, S. *Coal Min. Process.;* 17: No. 2, 60-62(Feb 1980).

Under present plans, the SRC process, during its demonstration stage, could produce 18,000 bbl/day of synthetic crude oil. However, coal liquefaction processes may produce substances which are carcinogenic, mutagenic or teratogenic.

34529 Mine Injuries and Worktime Quarterly, January-December 1979. *Mine Inj. Worktime Q.;* 1-18(Jan 1979).

All current-year data are preliminary and subject to change. The data are compiled from reports by operators of mines for personnel directly engaged in production, cleaning, milling, shipping, development, and maintenance and repair work, including direct supervisory and technical personnel and contract mining services. Reports are submitted as required under the Federal Mine Safety and Health Act of 1977, Public Law 91-173 as amended by Public Law 95-164. Compilations are based on reports received at the Health and Safety Analysis Center as of the 25th of the month (or first subsequent workday) following the end of the reported quarter.

REGULATIONS

34530 (PB—80-119407) The economic impact of proposed amendments to Chapter 4, mine-related pollution (R76-20 and R77-10). Final report. Lybecker, D.W.; Hood, W.C. (Southern Illinois Univ., Carbondale (USA)). May 1979. 89p. NTIS, PC A05/MF A01.

This report is the economic impact study of the proposed changes to Chapter Four of the Illinois Pollution Control Board regulations as reported in R77-10. The proposed addition of the definition, Mining Storage Facility, as reported in R76-20 is assumed to be included in the analysis of the proposed revised Chapter four. The principal changes in the proposed Chapter Four include: (1) Add or significantly modify nine definitions, (2) Include Coal Transfer Facility or Coal Storage Yard under Chapter Four rather than Chapter Three Regulations, (3) Exempt of Domestic Retail Sales Yards from state permits unless they create pollution, (4) Inclusion of the NPDES program into the Chapter Four regulations, (5) Require construction and operating permits, (6) Replace the abandonment permit with an abandonment plan, and (7) Change the effluent standards to comply with federal standards.

34531 (PB—80-121239) Coal and Illinois industry - the impact of the National Energy Acts of 1978. Final report. (Illinois Inst. of Natural Resources, Chicago (USA)). Oct 1979. 62p. NTIS, PC A04/MF A01.

Provisions of the Fuel Use Act, the Natural Gas Policy Act, and the Energy Tax Act are reviewed and their maximum impacts upon fuel use in 1985 and 1990 are estimated.

34532 (PB—80-126469) Coal conversion control technology. Volume I. Environmental regulations; liquid effluents. Final report, April 1977-November 1978. Bostwick, L.E.; Smith, M.R.; Moore, D.O.; Webber, D.K. (Pullman Kellogg, Houston, TX (USA)). Oct 1979. Contract EPA-68-02-2198. 540p. NTIS, PC A23/MF A01.

This volume is the product of an information-gathering effort relating to coal conversion process streams. Available and developing control technology has been evaluated in view of the requirements of present and proposed federal, state, regional, and international environmental standards. The study indicates that it appears possible to evolve technology to reduce each component of each process stream to an environmentally acceptable level. It also indicates that such an approach would be costly and difficult to execute. Because all coal conversion processes are net users of water, liquid effluents need be treated only for recycling within the process, thus achieving essentially zero discharge. With available technology, gaseous emissions can be controlled to meet present environmental standards, particulates can be controlled or eliminated, and disposal of solid wastes can be managed to avoid deleterious environmental effects. This volume (I) focuses on environmental regulations for gaseous, liquid, and solid wastes, and the control technology for liquid effluents.

34533 Coal development in the Northern Great Plains: the impact of revenues of state and local governments. Stinson, T.F.; Voelker, S.W. Washington, DC; Economics, Statistics, and Cooperatives Service (1978). 66p.

Development of coal resources in the Northern Great Plains need not create major financial problems for State and local governments. But while total state-local revenues will be adequate, some levels of governments, such as cities, may face serious revenue shortfalls when they provide additional services. Others, particularly the states, will have a surplus. These estimates are based on coal mines typical of those which might locate in Montana, North Dakota, South Dakota, and Wyoming, and on 1976 tax laws in those states. The estimates were obtained by using the ENERGYTAX simulation model. Cities face particularly serious financial problems, with potential expenditures for increased services outpacing new revenues by more than 2 to 1. School districts which receive large numbers of new students but do not have mine property within their boundaries will have similar problems. State and local governments may also face a cash flow problem when mineral development occurs. During the mine's construction and development phase, and during the period when the mine is being closed down, local governments will be required to provide services for the mine's employees at a time when tax revenues from the mine are minimal. Taxing at a rate somewhat higher than necessary during the operating years of the mine in order to provide the funds necessary for services during the low revenue years is one way the front end and closedown problems can be minimized. Finally, mines may inflict other social costs on the residents of a state or region. Increased taxes on the mines and decreased taxes on individuals can partially compensate for these costs.

PETROLEUM

REFER ALSO TO CITATION(S) 35859

RESERVES

34534 Appendices to Oil and Gas Production, Reserves and Resources in Wyoming report. Cheyenne, WY; Barlow and Haun, Inc. (1978). 90p. (NP—25071). Wyoming Dept. of Economic Planning and Development, Barrett Bldg., 2301 Central Ave., Cheyenne, WY 82002.

This is the Appendix Supplement to the report on Oil and Gas Production, Reserves and Resources in Wyoming. The 7 appendices have been arranged by basins which are: Bighorn Basin; Powder River Basin; Wind River Basin; Hanna-Laramie Basin; Green River Basin; Denver Basin; and Overthrust Belt. Each appendix contains a basin statistical summary and an illustration showing the past drilling and the percentage of drilling done in each basin as compared with the total Wyoming drilling. Each appendix also contains cumulative production data, discovery dates, location, and field names of each field with the basin. Remaining reserve estimates were derived from several data sources which are listed in each Basin Statistical Summary under Data Source. The appendix supplement is not included with the text portion of the study. It is available upon request from The Minerals Division of the Wyoming Department of Economic Planning and Development.

34535 Oil and gas production, reserves and resources in Wyoming. Cheyenne, WY; Barlow and Haun, Inc. (1978). 20p. (NP—25078). Wyoming Dept. of Economic Planning and Development, Barrett Bldg., 2301 Central Ave., Cheyenne, WY 82002.

This is an analysis of the oil and gas occurrence in the seven main basins in Wyoming: Bighorn Basin, Powder River Basin, Wind River Basin, Hanna-Laramie Basin, Green River Basin, Denver Basin, and Overthrust Belt. Appendices have been arranged by basin and each appendix contains a basin statistical summary and an illustration showing the past drilling and the percentage of drilling done in each basin as compared with the total Wyoming drilling. Each appendix also contains cumulative production data, discovery dates, location and field names of each field with the basin. Remaining reserve estimates were derived from several data sources which are listed in each Basin Statistical Summary under Data Source. The appendix supplement is not included with this text portion of the study. It is available upon request from the Minerals Division of the Wyoming Department of Economic Planning and Development.

GEOLOGY AND EXPLORATION

34536 Geology of continental margins. Tulsa, OK; American Association of Petroleum Geologists (1979). 128p. (NP—25126).

With continued high interest in offshore petroleum exploration, the 1977 AAPG Short Course presents the latest interpretations of new data bearing on the geology and geophysics of continental margins. Seven well-known earth scientists have organized an integrated program covering major topics involved in the development of ocean basins and continental margins with emphasis on the slopes and rises. The discussion of plate tectonics and evolution of conti-

nental margins is followed by presentations on the stratigraphy and structure of pull-apart and compressional margins. Prospective petroleum source rocks, their organic content, rate of burial, and distribution on slopes and rises of different margin types is covered. Prospective reservoir rock patterns are related to depositional processes and to the sedimentary and structural histories for different types of continental margins. Finally, the seismic recognition of depositional facies on slopes and rises for different margin types with varying rates of sediment supply during eustatic sea-level changes are discussed. The course with this syllabus offers an invaluable opportunity for explorationists to refresh their understanding of the geology associated with an important petroleum frontier. In addition, the course sets forth a technical frame of reference for the case-histoy papers to be presented later in the AAPG Research Symposium on the Petroleum Potential of Slopes, Rises, and Plateaus.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 34534, 34535

34537 (DOE/ET/12057—6) **Bodcau In Situ Combustion Project. Third annual report, July 1, 1978-August 31, 1979.** Garvey, J.; Pusch, W.H.; Fulford, R.S. (Cities Service Co., Jackson, MS (USA)). Aug 1980. Contract AC03-76ET12057. 66p. NTIS, PC A04/MF A01.

This project is a cooperative venture between Cities Service Company and the US Department of Energy. The main objective is to demonstrate the operation and economics of a successful commercial scale In Situ Combustion Project in a heavy oil reservoir. This Third Annual Report deals primarily with performance, development and economics of the project in the third year of operation, with pertinent information from the First and Second Annual Report included for background information. The five elongated patterns were developed for this demonstration on Cities Service Company's Bodcau Fee B lease in the Bellevue Field, Bossier, Parish, Louisiana. This field was discovered in 1921 and is a dome type structure covering approximately 900 productive acres. Production is from the Upper Cretaceous Nacatoch Sand occurring from 300 to 400 feet deep. Primary production by fluid expansion and later gravity drainage amounted to only about five percent of the original oil-in-place. Thirty-eight producers, five injectors and five temperature observation wells are included in the 19-acre project. Estimated recoverable reserves from the project is 700,000 barrels. During the first three years of the contract, cumulative air and water injection has been 7,046,589 MCF and 1,319,270 barrels. Oil production has been 449,816 barrels. This recovery represents 64% of the total estimated recoverable reserves. Current expense at the field level for operations, development, maintenance, well service and Louisiana Severance Total Tax is $10.60 per gross barrel produced.

34538 (DOE/SF/0113—4) **Carbon dioxide for the recovery of crude oil. Annual report, November 1978-November 1979.** Doscher, T.M. (University of Southern California, Los Angeles (USA)). Aug 1980. Contract AM03-76SF00113. 61p. NTIS, PC A04/MF A01.

The displacement of residual oil to waterflooding by miscible fluid injection has been studied using scaled physical models of line-drive systems. The effects of flow rate, mobility ratio, and density ratio, were investigated. This work was a first step in an overall program of studying miscible displacement in particular by carbon dioxide, of residual oil as a process for recovering additional crude oil from reservoirs which had been waterflooded. The ratios of gravitational and viscous forces which exist in tertiary recovery operations, using carbon dioxide as a recovery reagent, were approximated in a scaled physical model at ambient pressure and temperature. The viscosity ratio was now very unfavorable and displacement of moveable water was inefficient. Consequently, the displacement of the residual oil by the solvent, which was simulating the role of carbon dioxide, was also poor. The recovery efficiency could not be improved by reasonable increases in the fluid velocity because the unfavorable mobility-caused viscous fingering was so dominant. Insomuch as carbon dioxide flooding, an imperfectly miscible recovery process, cannot be expected to perform as well as a perfectly miscible recovery process, these experiments point to the need for imposing a strong measure of mobility control if the injection of carbon dioxide is to achieve widespread usage for the recovery of residual oil.

34539 (PB—80-110869) **Analysis of water resources requirement for the enhanced (tertiary) oil recovery in the southern plains region of the United States.** Shih, C.S.; Hamilton, S.H. (Texas Univ., San Antonio (USA). Div. of Environmental Studies). Sep 1979. Contract DI-14-34-0001-8120. 222p. NTIS, PC A10/MF A01.

This report analyzes the water resources requirements, in terms of both water quantity and quality, for the anticipated enhanced oil recovery operations to be implemented in the southern plains region of the United States. The enhanced oil recovery potential of each oil-producing reservoir in the four states of Texas, Oklahoma, New Mexico, and Louisiana is assessed using parameters describing the basic characteristics of crude oil and the reservoir formation. The water resources, including the surface water and groundwater resources will be delineated by producing subregions. An analysis has been performed to determine the incremental water demand and water quality requirements for enhanced oil recovery operations based on overall domestic, agricultural, and industrial demands versus water resources available. Potential enhanced oil recovery productions associated with alternative pricing scenarios are used in the assessment of water resources constraining effects. The water quality impacts of enhanced recovery method are assessed considering surface water pollution by discharged chemicals and waste waters, groundwater pollution by the fracture of well casings, and infiltration of chemicals and oil/water mixtures.

34540 **Metal seal tubing plug.** Regan, L.M.; Childers, T.W.; Anderson, R.E.; Burkhardt, J.A. (to Exxon Production Research Co.). US Patent 4,178,992. 18 Dec 1979. Filed date 30 Jan 1978. 6p.

A metal seal plug for use in sealing a tubing run is disclosed. The plug includes upper and lower tubular housings connected together for limited movement therebetween by an inner mandrel. The lower housing contains a locking unit which when actuated locks into a recess formed in the tubing to lock the plug in the tubing. The upper housing contains an actuator for actuating the locking unit when the upper housing is forced down with respect to the lower housing. The lower housing also contains a metal seal ring which engages metal sealing surfaces on the tubing and on the lower housing to seal off the space between the plug and the tubing. The distance between the locking unit and the metal seal ring and the distance between the recess and the sealing surface on the tubing run are selected to ensure that the metal seal ring is properly loaded when the plug is locked in the tubing. Initially, shearable means releasably secures the mandrel to the upper tubular member to prevent movement between the upper and lower housings. The lower end of the plug may be a closed nose member or a diverter to be positioned in a curved tubing run of a Y-spool.

PROCESSING

REFER ALSO TO CITATION(S) 34494, 34577, 35239

34541 (DOE/EIA—0111/79) **Energy data reports: petroleum refineries in the United States and US territories.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1 Jan 1979. 29p. NTIS, PC A03/MF A01.

Tables are presented for number and capacity of petroleum refineries in the United States and US territories; capacity of petroleum refineries in the United States and US territories; capacity of downstream facilities to which crude oil is charged directly; capacity of facilities under construction; and storage capacity at refineries in the United States.

34542 **Combination residual oil hydrodesulfurization and thermal cracking process.** Frayer, J.A.; Stauffer, H.C.; Wynne, F.E. Jr.; Yanik, S.J. (to Gulf Research and Development Co.). US Patent 4,179,355. 18 Dec 1979. Filed date 20 Oct 1977. 16p.

In accordance with the present invention, the high boiling residual components of a thermal cracker feed residual oil are selectively removed during hydrodesulfurization to provide a non-aliquot distillate-residual oil hydrodesulfurization product in which the ratio of lower boiling distillate oil to high boiling residual oil is enhanced. Modifying the aliquot distribution of distillate and residual components in this manner provides an interdependent effect in the combination process since the distillate-enriched cracking feedstock not only provides both an improved ethylene yield and a greater steam economy in the thermal cracking operation but it also reduces hydrogen consumption in the hydrodesulfurization operation. Further interdependence between the hydrodesulfurization and thermal cracking operations is obtained by utilizing the residual oil which is selectively removed during the hydrodesulfurization step as fuel in the solids regenerator of the cracking unit, thereby making the more valuable, highly aromatic black oil produced in the thermal cracking process available for conversion to needle coke and carbon black.

34543 **Conversion of low octane number alkylate to high octane gasoline and aromatics.** Hutson, T. Jr.; Farha, F.E. Jr. (to Phillips Petroleum Co.). US Patent 4,179,353. 18 Dec 1979. Filed date 6 Jul 1977. 6p.

An intentionally produced low octane value alkylate is reformed in the presence of steam, and in the absence of added hydrogen, to produce a high octane value, olefinic reformate containing aromatics. The reformate, upon fractionation to remove hydrogen and methane and C_5 and C_4 hydrocarbons, which can be recycled, is subjected to solvent extraction to produce a raffinate which can be used as high octane gasoline and which contains olefins, and an extract which, upon fractionation to remove xylenes

therefrom as usable product, and which now contains benzene and toluene, can be combined with the raffinate.

34544 1978 proceedings: Refining Department. Volume 57. Washington, DC; American Petroleum Institute (1978). 527p. (CONF-7805201—).

From 43. American Petroleum Institute midyear meeting; Toronto, Canada (8 May 1978).

Individual papers were abstracted separately for the data base.

34545 Coal fired fluidized bed process heater studies. Cherrington, D.C.; Golan, L.P. (Exxon Research and Engineering Co., Florham Park, NJ). pp 164-182 of 1978 proceedings: Refining Department. Volume 57. Washington, DC; American Petroleum Institute (1978).

From 43. American Petroleum Institute midyear meeting; Toronto, Canada (8 May 1978).

A DOE/Exxon jointly funded program is underway to make a technical and economic evaluation of coal fired fluidized bed combustion technology as it might be applied to design of refinery and petrochemical plant indirect fired process heaters. The early phases of the program involve a series of laboratory investigations designed to generate the information and engineering data needed to make this evaluation. Specific areas under study include: (a) the effects on fluidization performance and heat transfer characteristics of immersing relatively large diameter tubes in a bed of fluidized limestone, and (b) the parameters affecting coke laydown on the inside surface of hydrocarbon containing tubes when exposed to the high heat transfer flux rates present in a fluidized bed. Program data are reported that describe the fluidization and heat transfer performance of six alternative tube bundle configurations that were fabricated from tubes up to 6 inches in diameter and arranged on 2-diameter, 3-diameter, and 4-diameter tube center-to-center horizontal spacing. The test results indicate some limiting relationships between operating parameters and physical tube bundle arrangement that will have to be observed in any commercial design. Both peripheral and tube-to-tube variations in heat transfer patterns are also described with some emphasis on differences observed in the fully immersed tubes, in the splash zone, and the freeboard tubes above the fluidized bed.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 34545, 34563

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 35391, 35585, 35586, 35587, 35591, 35592, 35593, 35594, 35595, 35607, 35614, 35617

34546 (PB—80-108855) **Western Gulf of Alaska petroleum development scenarios local socioeconomic impacts. Final report.** Waring, K.; Smythe, T.J. (Alaska Consultants, Inc., Anchorage (USA)). Sep 1979. Contract DI-AA550-CT6-61. 288p. NTIS, PC A13/MF A01.

The socioeconomic report projects and analyzes how the proposed Western Gulf of Alaska OCS Lease Sale No. 46 might affect the growth and community infrastructure of Seward and Kodiak, Alaska. Growth impact forecasts were prepared for a base case (without OCS Sale No. 46) and for three (low, mean, high) hypothetical petroleum development scenarios. In the growth impact analysis, particular consideration was given to the following factors: employment, population, housing and land use, public utilities (water, sewer, electric power, solid waste, communications), police and fire protection, health and social services, education, recreation and local governmental finances. The report Appendix describes the methodology used to develop employment and population growth forecasts (especially in relation to the OCS development scenarios) and to translate this growth into forecasts of future demand for housing and land, community facilities and services, and future impact upon local public revenues and expenditures.

MARKETING AND ECONOMICS

34547 (DOE/EIA—0115(76)) **Supply, demand, and stocks of all oils by P.A.D. districts and imports to the United States, by country.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Feb 1978. 10p. NTIS, PC A02/MF A01.

This report presents data on the USA petroleum industry for the year 1976. Domestic production of crude oil and natural gas liquids per day is given. Data on imports of all oils - crude oil and refined products are given. Imports in 1976 accounted for 41% of the total oil supply. OPEC supplied the US with 69% of the total oil imported. Data on crude oil inputs to refineries per day and refinery yields are given. Data on total domestic product demand per day, including gasoline, fuel oil, residual fuel oil, liquefied gases, jet fuels and aviation fuel, are given. Data on stocks of all oils at the end of 1976 are included. (DMC)

34548 (NP—25121) **Economy calculation to determine the optimum plant parameters for peak coverage with stored liquefied natural gas.** Backhaus, H. (Koeln Univ. (Germany, F.R.). Wirtschafts und Sozialwissenschaftlichen Fakultaet). 8 Feb 1979. 268p. (In German). NTIS (US Sales Only), PC A12/MF A01.

The economical supply of natural gas is faced with particular problems due to the considerably fluctuating demand as a result of the greatly varying course of temperature; the infrastructure of the gas distribution of largely fluctuating loads is particularly effected. As the utilization structure deteriorates however, the higher specific gas costs rise. It is hence necessary for gas supply optimization, to extensively adapt the gas bought to the gas sold especially when trying to compare with the import. Storage plays a key role in this. Starting with the annual normal line, mathematical relationships are developed for peak coverage wth liquefied natural gas which however, are set up in such a way that every other peak coverage process can be analyzed according to costs and the parameters optimized. A few selected model cases are treated (gas supply undertakings of various sizes, different gas drawing and supply conditions).

34549 (PB—80-121429) **Petroleum shortage response program for the State of Illinois. Phase II: six- to 24-month actions.** (Barton-Aschman Associates, Inc., Evanston, IL (USA)). Jun 1979. 101p. NTIS, PC A06/MF A01.

The Petroleum Shortage Response Program: Phase II is a suggested course of action to be undertaken by the State of Illinois operating through the Illinois Institute of Natural Resources in the event of a fuel shortfall of up to 25 percent lasting for a period of more than six months to bring fuel supply in line with fuel demand.

34550 (PB—80-125842) **U.S. Strategic Petroleum Reserve at a turning point - management of cost, oil supply problems, and future site development.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 2 Jan 1980. 38p. NTIS, PC A03/MF A01.

Effectiveness of the cost tracking or other cost control procedures used in the Strategic Petroleum Reserve program, failure of oil suppliers to deliver oil for the Reserve under their contracts, and three noncompetitive turnkey contract negotiations for procuring new Strategic Petroleum Reserve storage facilities.

34551 (PSAD—80-30) **Purchase price of Strategic Petroleum Reserve oil fair but payment timing is costly.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 3 Apr 1980. 34p. General Accounting Office, Washington, DC.

Report to the Congress by the Comptroller General of the United States.

The Defense Fuel Supply Center does a good job of negotiating competitive market prices for Strategic Petroleum Reserve crude oil purchases. However, new Treasury policies, which preclude paying bills before they are due and taking prompt payment discounts costing more than they save, have not been adequately implemented. If payment procedures were improved, the Government could save $17.7 million on the remaining crude oil purchases. Another $18.5 million could be saved in crude oil costs alone by new policies requiring (1) all agencies to consider the Government's cost of money while evaluating bids and (2) the Department of the Treasury to develop and periodically revise an estimate of the cost of money to be used during offer and payment evaluations.

34552 Price, quantity, and causality in the production of crude petroleum in the United States. Uri, N.D. (DOE, USA). *Energy Sources (N.Y.);* **5**: No. 1, 31-43(1980).

This paper describes a test for bidirectional causality and applies the test to price and the quantity of crude petroleum produced in the United States. The results clearly indicate that the quantity of crude petroleum produced is causally related to price but that price is not causally related to quantity. Consequently, one should not estimate a relation from these data, treating production as exogenous with price on the left-hand side. Further, no evidence appears to contradict the assumption that price can be treated as exogenous in a regression of quantity on future, current, and past prices. 11 refs.

WASTE MANAGEMENT

34553 (DOE/BC/10044—8) **Feasibility study for the retrofitting of used oil re-refineries to the BETC solvent treatment/distillation process.** Weinstein, N.J.; Brinkman, D.W. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center;

Recon Systems, Inc., Somerville, NJ (USA)). Sep 1980. Contract AC19-79BC10044. 42p. NTIS, PC A03/MF A01.

Federal policy encourages recycle of used oil, but requires that recycling be done in an environmentally sound manner. In order to encourage such recycling the Bartlesville Energy Technology Center of the US Department of Energy has developed the DOE/BETA solvent treatment/distillation re-refining process. The feasibility of retrofitting existing used oil re-refineries to the DOE/BETC process has been studied in this work. Twelve potential sites were chosen from almost 300 firms thought to be interested in re-refining technology. Three of these twelve sites have been recommended as prime candidates.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 34539, 35464, 35476, 35477, 35492

34554 (AD-A—078431/4) **Engineering evaluation of sorbent dispensing/collection system-universal mounting arrangement. Final report.** Skaalen, C.I.; Rausch, A.B. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Feb 1979. Contract MIPR-Z-70099-7-73715-A. 46p. NTIS, PC AA03/MF A01.

The success of the Sorbent Oil Recovery System in the open sea will depend greatly on its mode of transportation through the oil slick. This study was made to identify optimum vessels and mounting concepts. Sorbent system requirements were established from which candidate vessels were identified. Alternative mounting concepts were defined and evaluated which resulted in the recommendation of developing a new component arrangement which minimizes interaction between the Sorbent Oil Recovery System and the candidate vessel.

34555 (AD-A—078621/0) **A chance-constrained goal programming model to evaluate response resources for marine pollution disasters. Research report.** Charnes, A.; Cooper, W.W.; Karwan, K.R.; Wallace, W.A. (Texas Univ., Austin (USA). Center for Cybernetic Studies). Apr 1979. Contracts N00014-75-C-0616;N00014-75-C-0569. 76p. NTIS, PC AA05/MF A01.

This paper develops a model to aid Coast Guard managers in formulating appropriate policies with respect to planning for various types of equipment required to contain major pollution incidents. The model is elaborated in terms of three primary stages of response: offloading, containment, and removal. The zero order rule of chance-constrained programming is used to obtain a deterministic equivalent of the original chance-constrained model. This is then replaced by a goal programming formulation to allow for plans that come 'as close as possible' to desired quality and risk levels for each pertinent region and type of incident. Numerical examples illustrate potential uses of the model with special emphasis on its value for budgetary (equipment) planning by central management that extends to evaluation of risk and performance quality levels, as well as the usual dual evaluator approaches for evaluating initially prescribed levels of equipment and their efficiency coefficients. (Author)

34556 **Proceedings of the workshop on government oil spill modeling, November 7-9, 1979, Wallops Island, Virginia.** Bishop, J.M. (comp.). Washington, DC; National Oceanic and Atmospheric Administration (1980). 29p. (CONF-7911109—(Absts.)).

From Workshop on Government oil spill modeling; Wallops Island, VA, USA (7 Nov 1979).

A workshop on Government Oil Spill Modeling Activities was convened by the Environmenta Data and Information Service (EDIS) of the National Oceanic and Atmospheric Administration (NOAA), November 7-9, 1979. The workshop brought together oil spill model users and modelers for the purpose of fostering joint communication and increasing understanding of mutual problems. The workshop concentrated on defining user needs, presentations of ongoing modeling programs, and discussions of supporting research for these modeling efforts. The basic goals were to assure that current efforts are consistent with user needs and to provide a forum for technology transfer.

34557 (PB—80-108830) **Manual of practice for protection and cleanup of shorelines. Volume I. Decision guide. Final report, April-July 1979.** Foget, C.R.; Schrier, E.; Cramer, M.; Castle, R. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Aug 1979. Contract EPA-68-03-2542. 124p. NTIS, PC A06/MF A01.

The purpose of this manual is to provide the on scene field user with a systematic, easy to apply methodology that can be used to assess the threat of an oil spill and select the most appropriate protection and cleanup techniques. This manual is structured to provide a decision-making guide to enable the user to determine, for a given oil spill situation, which protection and cleanup techniques would be most effective for a specific shoreline type. A detailed discussion of the factors involved in the decision-making process is also given and includes oil characteristics, behavior and movement of oil, shoreline characterization and sensitivity, protection and cleanup priorities and implementation requirements, and impacts associated with cleanup operations.

34558 (PB—80-108848) **Manual of practice for protection and cleanup of shorelines. Volume II. Implementation guide. Final report, April-July 1979.** Foget, C.R.; Schrier, E.; Cramer, M.; Castle, R. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Aug 1979. Contract EPA-68-03-2542. 137p. NTIS, PC A07/MF A01.

The purpose of this manual is to provide the on scene field user with a systematic, easy to apply methodology that can be used to assess the threat of an oil spill and select the most appropriate protection and cleanup techniques. A detailed discussion of the factors involved in the decision-making process is also given and includes oil characteristics, behavior and movement of oil, shoreline characterization and sensitivity, protection and cleanup priorities and implementation requirements, and impacts associated with cleanup operations.

34559 **Report to the Regional Response Team Coastal Region II, Third Coast Guard District: a climatological oil spill planning guide. No. 1: the New York Bight.** Bishop, J.M. (comp.). Washington, DC; National Oceanic and Atmospheric Administration (1980). 128p. (NP—25113).

Oil spills are a major concern associated with both offshore oil production and movement of oil through the Mid-Atlantic Bight area. This report summarizes appropriate environmental data, discusses the movement of oil at sea, and attempts to predict the effects of oil spills for the New York Bight, a region lying between Montauk Point, NY, and Cape May, NJ. The concept that a report of this type should be available was initially developed during the grounding of the Argo Merchant. At that time, and even to the present, there is no source of key environmental data available related to oil spills for regional response planning. The objective of this study is to provide this information in a format that can be both understood and used by decision makers for oil spill contingency planning and for scientific support personnel during spills.

34560 **Oil coagulant and process for preparation thereof.** Matsuda, Y.; Tomita, S.; Abe, K.; Terajima, K. (to Agency of Industrial Science and Technology). US Patent 4,178,265. 11 Dec 1979. Priority date 24 Feb 1977, Japan, 12p.

A mixture of a carboxymethylated yeast with a higher fatty acid and the like is prepared, and a water-soluble polyvalent metal salt of an inorganic acid is added to the mixture in the presence of water. The resulting composition has an oil-coagulating effect.

POLICY, LEGISLATION, AND REGULATION

34561 (DOE/BC/00050—15) **Environmental regulations handbook for enhanced oil recovery. Final report.** Wilson, T.D. (Spears and Associates, Inc., Tulsa, OK (USA)). Aug 1980. Contract AC19-78ET12383. 210p. NTIS, PC A10/MF A01.

A guide to environmental laws and regulations which have special significance for enhanced oil recovery (EOR) is presented. The Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, Resource Conservation and Recovery Act, federal regulations, and state regulations are discussed. This handbook has been designed as a planning tool and a convenient reference source. The 10 states included comprise the major oil-producing states in various regions of the state. The major topics covered are: general guidelines for complying with environmental laws and regulations; air pollution control; water pollution control; protecting drinking water: underground injection control; hazardous waste management; and federal laws affecting siting or operation of EOR facilities. (DMC)

TRANSPORT, PIPELINES, AND HANDLING

34562 **Method and apparatus for displacing oil and seawater in tanks of an oil tank.** Iizuka, J.; Kato, S.; Matsuda, A. (to Sumitomo Electric Industries Ltd.). US Patent 4,178,868. 18 Dec 1979. Filed date 17 Mar 1978. 6p.

Each of compartments of an oil tanker is divided by a flexible membrane into first and second sections one of which is used as an oil chamber. The membrane is made of an oil-resistant and chemical-resistant material. When an oil is loaded, the second section is unloaded, the second section is filled with a ballasting seawater, crashing the first section.

PROPERTIES

34563 (DOE/BETC/PPS—80/3) **Motor gasolines, winter 1979-1980.** Shelton, E.M. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jul 1980. 72p. NTIS, PC A04/MF A01.

Analytical data for 1857 samples of motor gasoline, were collected from service stations throughout the country and were analyzed in the laboratories of various refiners, motor manufacturers, and chemical companies. The data were submitted to the Bartlesville Energy Technology Center for study, necessary calculations, and compilation under a cooperative agreement between the Bartlesville Energy Technology Center (BETC) and the American Petroleum Institute (API). The samples represent the products of 48 companies, large and small, which manufacture and supply gasoline. These data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing districts into which the country is divided. A map included in this report shows marketing areas districts and sampling locations. The report also includes charts indicating the trends of selected properties of motor fuels since 1949. Twelve octane distribution percent charts for areas, 1, 2, 3, and 4 for unleaded, regular, and premium grades of gasoline are presented in this report. The antiknock (octane) index [(R+M)/2] averages of gasoline sold in this country were 87.9, 92.1, 89.0, and 93.3 unleaded below 90.0, unleaded 90.0 and above, regular, and premium grades of gasolines, respectively.

STORAGE

REFER ALSO TO CITATION(S) 34541, 34548, 34608

COMBUSTION

REFER ALSO TO CITATION(S) 34518, 34882

NATURAL GAS

RESERVES

REFER ALSO TO CITATION(S) 34534, 34535

GEOLOGY AND EXPLORATION

34564 (DOE/BC/10026—27) **Electromagnetic impedance sonde for evaluation of tight gas reservoirs. Quarterly progress report, April 1-June 30, 1980.** Schuster, C.L. (Sandia Labs., Albuquerque, NM (USA)). 10 Jul 1980. Contract AT19-79BC10026. 14p. NTIS, PC A02/MF A01.

Progress is repoted under: dielectric modeling, lab measurements, and sonde modeling. 2 figures. (DLC)

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 34534, 34535, 34540, 34544

34565 (DOE/EIA—0133/77) **World natural gas: 1977.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 20 Jul 1979. 11p. NTIS, PC A02/MF A01.

In this report, tables are presented for natural gas production by countries; gross production of natural gas by type of well; natural gas used for repressuring or wasted by countries, and world natural gas trade.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 34620

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 34565, 34568

34566 (DOE/EIA—013(78)) **Natural gas production and consumption.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 12 Oct 1979. 12p. NTIS, PC A02/MF A01.

Data are presented on the marketed production of natural gas in the USA, imports of natural gas, natural gas consumption and withdrawals from underground facilities for 1978. Withdrawals and dispositions for 1977 and 1978 are tabulated according to individual state. Marketed production, interstate shipments, and total consumption are tabulated according to state and region. The number of producing wells in the USA are tabulated by district and state. (DMC)

34567 (DOE/EIA—0188(79)) **US imports and exports of natural gas, 1979.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 3 Jun 1980. 14p. NTIS, PC A02/MF A01.

United States pipeline imports and exports of natural gas and of liquefied natural gas (LNG) are given for 1979. Data are filed on Federal Energy Regulatory Commission (FERC) Form FPC-14 by 28 pipeline companies. Volume and unit cost for imports and for exports of both natural gas and LNG are given by company and by year. Most data are for the two most recent years, with a summary table of the US natural gas pipeline import/export balance since 1955. An introductory text highlights gas and LNG imports and exports for the countries of destination. 7 tables.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 35476, 35477

POLICY, LEGISLATION, AND REGULATION

34568 (DOE/EIA—0201/3) **Pricing provisions of the Natural Gas Policy Act of 1978. Energy Policy Study, Volume 3.** Dickens, P.F. III; Thrasher, R. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 96p. NTIS, PC A05/MF A01.

The Natural Gas Policy Act of 1978 represents a major change in the regulation of natural gas. The Act extends the authority of the Federal Energy Regulatory Commission to virtually all natural gas production, establishes a set of ceiling prices for natural gas at the wellhead, and provides a method for allocating the costs of high-cost gas among end users. This study was conducted to explore the effects of the current regulatory structure on the prices and quantities observed in the markets for natural gas and to compare the regulated markets with the results that might be expected to exist in the absence of specific controls on natural gas markets. To assist in this effort, first of all, a short description of the natural gas market, the production process, and a brief review of past regulation are presented. The pricing provisions of the NGPA, effects of the NGPA pricing, incremental pricing and its effects, and non-price allocation on natural gas curtailments and priority access are covered in detail. The general conclusion is that relative to an unregulated market, the price controls of the NGPA have the effect of redistributing wealth from producers of natural gas to consumers. To the extent that society values the redistributive aspects of the controls, this Act may offset or exceed the valuation of the efficiency loss relative to a free market occasioned by these programs.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 34567

PROPERTIES

34569 (PB—80-107337) **NBS research on LNG thermophysical properties data and custody transfer measurement methods. Final report.** Diller, D.E. (National Bureau of Standards, Washington, DC (USA)). 1978. 6p. Pub. in Proceedings of the Storage and Transfer of LNG Conference, Boumerdes, Algeria, April 4-5, 1978, p125-130 1978.

Developments in LNG thermophysical properties data research at NBS are reviewed and discussed. These include projects on the PVT, thermodynamic, electromagnetic and transport properties of pure LNG components; and on the liquid-vapor equilibrium properties and orthobaric liquid densities of mixtures of LNG components. Developments in LNG custody transfer measurement research are reviewed, with emphasis on accurate methods for determining LNG composition, density, specific heating value, flow rate and ship tank capacity tables for LNG custody transfer. The uncertainties in the determination of the total heating value of large quantities of LNG in tanks and pipelines are discussed.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 34464

RESERVES AND EXPLORATION

34570 (DOE/LETC/RI—80/11) **Shallow oil shale resources of the southern Uinta Basin, Utah.** Dana, G.F.; Smith, J.W.; Trudell, L.G. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Sep 1980. 43p. NTIS, PC A03/MF A01.

The shallow Green River Formation oil shales in the southern part of Utah's Uinta Basin are potentially developable by strip mining or by subsurface techniques which take advantage of limited overburden. The resource of potential shale oil represented by the shallow deposits is evaluated in detail from corehole oil-yield data. Cross-sections are constructed to readily correlatable stratigraphic units selected to represent resources in the shallow shale. To define each unit, the thickness, average oil yield, and oil resource of each unit in each core are calculated. Contour maps constructed from these data define the resource variation across the shallow resource. By measuring areas enclosed in each resource unit within the defined limit of 200 feet (61 meters) of overburden, the resource represented by the shallow oil shale is evaluated. The total resource is measured as 4.9 billion barrels (779.1 billion liters) of potential shale oil at depths less than 200 feet (61 meters). The rich zone incorporates the Mahogany bed, the best shallow oil-shale unit. This section, currently being exploited by Geokinetics, Inc., for in situ production of shale oil by horizontal combustion, represents 2.2 billion barrels (349.8 billion liters) of potential shale oil in place.

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

REFER ALSO TO CITATION(S) 34570, 35389

34571 (FE—2346-79) **Mineralogy of Antrim Shale, Michigan.** Ruotsala, A.P. (Dow Chemical Co., Midland, MI (USA)). 31 Jul 1980. Contract AC01-76ET12153. 94p. NTIS, PC A05/MF A01.

Semi-quantitative x-ray mineralogical determinations were made for 12 surface, 104 core, and 707 samples from oil well cuttings distributed throughout the Michigan Basin. In addition, 15 samples that had undergone retorting were checked for mineralogical changes. Gold, uranium, thorium, and rare-earth abundances were obtained for 22 samples from drill core at the Dow Chemical Company drill site in Sanilac County, Michigan. Typical Antrim Shale is composed of 50 to 60% quartz, 20 to 35% illite, 5 to 10% kaolinite, 0 to 5% chlorite, and 0 to 5% pyrite. Bedford Shale, which overlies the Antrim in eastern Michigan, has higher contents of total clays, illite, and kaolinite, and lower quartz contents. Ellsworth Shale, which grades laterally into Antrim in western Michigan, contains significant dolomite. Antrim Shale from the southern and eastern margins of the Michigan Basin contains as much as 15% kaolinite, while samples from the northern, central and western portions contain up to 5% chlorite. Illite and quartz contents tend to be highest in the deepest part of the basin, where the Antrim is thickest. Uranium content increases upward to about 40 ppM and is greatest within shales of the Antrim. Limestone interbeds contain up to about 9 ppM uranium. Highest uranium contents are found just beneath the limestone interbeds and just beneath Bedford Shale. Thorium contents, on the other hand, tend to be uniformly 10 to 12 ppM in Antrim Shale and up to 4 ppM in limestone interbeds. Gold contents range up to about 0.05 ppM in Antrim Shale and 0.01 to 0.02 ppM in limestone interbeds. Rare-earth abundances in Antrim Shale are lower than average North American shales. In the case of most rare earth elements, the overlying Bedford Shale has higher contents of most rare-earth elements.

34572 (FE—2346-82) **Lithologic examination of cores and well cuttings from the Antrim Shale.** Briggs, L.I.; Elmore, R.D. (Dow Chemical Co., Midland, MI (USA)). Aug 1980. Contract AC01-76ET12153. 36p. NTIS, PC A04/MF A01.

Cores from three wells and a portion of the core of a fourth well drilled in Sanilac County, Michigan were subjected to lithologic examination. These cores began in the Bedford shale and extended through the Antrim shale into the Traverse Formation. The predominant minerals were illite, chlorite, dolomite and quartz. Numerous fossils were observed.

DRILLING, FRACTURING, AND MINING

34573 (FE—2346-67) **Energy from true in situ processing of antrim shale: preparation of in situ retort bed by explosive underreaming and fracturing.** Peil, C.A. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Jul 1980. Contract AC01-76ET12153. 121p. NTIS, PC A06/MF A01.

This report summarizes the work carried out on the explosive underream and fracturing of Antrim shale. This experiment involved the creation of a cavity in the shale by detonating successively larger explosive shots in a central wellbore. Two more wells were located, drilled and cored 15 feet either side of the central well. Core analysis of these wells indicated that one well had a high concentration of fractures which were likely induced explosively, while the other well had few fractures thought to have been explosively induced. Interwell communication established by fluid injection confirmed the differences. A gyroscopic survey of the borehole shed some light on this difference. The well containing the extensive fracturing remained 15 feet from the bottom of the central well, while the distance to the second well had increased 63%. The wells were loaded with a slurry explosive system and detonated. The wellbores were cleaned out and the results were evaluated with flow logging, air permeability, tracer gas, differential temperature, borehole television and vertical seismic profiling techniques. The results defined the degree of interwell communications, the location of major fractures, and indicated that five of the seven wells were in some degree of communication. The major zone of permeability was through vertical fractures forming a wedge between three of the wells. An effective system for monitoring and pumping of formation fluids was designed and installed. The results of a post-fracture vertical seismic profile survey corroborated other logging techniques and confirmed the existence of a complex fracture system at depths ranging from 1230 to 1375 feet. The fracture system was defined as being a larger planer zone, 70 to 100 feet wide and 70 to 100 feet high.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 3 5239

IN SITU METHODS, TRUE AND MODIFIED

34574 (DOE/LETC/10787—48) **Investigation of the geokinetics horizontal in situ oil shale retorting process. Quarterly report, April, May, June 1980.** Hutchinson, D.L. (Geokinetics, Inc., Concord, CA (USA)). Aug 1980. Contract FC20-78LC10787. 196p. NTIS, PC A09/MF A01.

The Retort No. 18 burn was terminated on May 11, 1980. A total of 5547 barrels of shale oil or 46 percent of in-place resource was recovered from the retort. The EPA-DOE/LETC post-burn core sampling program is underway on Retort No. 16. Eleven core holes (of 18 planned) have been completed to date. Preliminary results indicate excellent core recovery has been achieved. Recovery of 702 ft of core was accomplished. The Prevention of Significant Deterioration (PSD) permit application was submitted to the EPA regional office in Denver for review by EPA and Utah air quality officials. The application for an Underground Injection Control (UIC) permit to authorize GKI to inject retort wastewater into the Mesa Verde Formation is being processed by the State of Utah. A hearing before the Board of Oil, Gas and Mining is scheduled in Salt Lake City, Utah, for July 22, 1980. Re-entry drilling on Retort No. 24 is progressing and placement of surface equipment is underway. Retort No. 25 blasthole drilling was completed and blast preparations are ongoing. Retort No. 25 will be blasted on July 18, 1980. The retort will be similar to Retort No. 24, with improvements in blasthole loading and detonation. US Patent No. 4,205,610 was assigned to GKI for a shale oil recovery process. Rocky Mountain Energy Company (RME) is evaluating oil shale holdings in Wyoming for application of the GKI process there.

34575 (FE—2346-84) **Correlations for the diffusivity and permeability for Devonian shale.** Cannon, T.J.; Johnston, D.A.; Fogler, H.S.; Schultz, J.S. (Dow Chemical Co., Midland, MI (USA)). Jul 1980. Contract AC01-76ET12153. 44p. NTIS, PC A03/MF A01.

Energy extraction from oil shale is a major facet of the expanding synthetic fuels program. In situ retorting of oil shale presents a method of recovering a portion of that stored energy content by inducing a flame front through the shale. Diffusivity and permeability are measures of the ease of movement of air toward the flame front and product gases away from the front. This study reports on measurements of diffusivity and permeability at seven depths within and below the Antrim shale for unretorted and retorted cores. The threshold pressures were also measured and compared to the predictions given by correlations. Finally, correlations were developed between the diffusivity, permeability and other physical properties.

34576 (UCID—16986-80-2) **Oil shale project. Quarterly report, April-June 1980.** Rothman, A.J. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01.

In this quarterly report, pilot retorting operations, field testing of retort operation and control, retort modelling and laboratory studies are covered in detail. Under the pilot retorting operations, preliminary results from small retort run S-20 which cover descriptions of the retort vessel and bed load, results of pre-run steam logging and summary of retort operations are included. Also, there is

a discussion on the critical effect shale grade has on yield. Laboratory studies of oil shale cover carbonate decomposition and char gasification, oil composition and hydrogen sulfide evolution. The final section deals with the Discrete Interacting Block System (DIBS) computer model and verification experiment. The model is being developed as a tool to aid in determining optimum methods of creating uniformly distributed porosity in modified in-situ retorts.

REFINING

REFER ALSO TO CITATION(S) 34542

34577 Refining shale oil. Sullivan, R.F. (Chevron Research Co., Richmond, CA); Stangeland, B.E.; Frumkin, H.A.; Samuel, C.W. pp 199-210 of 1978 proceedings: Refining Department. Volume 57. Washington, DC; American Petroleum Institute (1978).

From 43. American Petroleum Institute midyear meeting; Toronto, Canada (8 May 1978).

Shale oil presents unusual refining problems. It is notable for high nitrogen content which can lead to poor product quality. It also contains large amounts of unsaturated and metallic contaminants. Its unusual properties prevent its being mixed with crude oils for processing in most existing refineries. However, advanced commercial state-of-the-art refining technology is capable of refining shale oil, either alone or admixed with crude. The key to successful shale oil refining is an effective initial hydrotreating step. This removes the contaminants and permits the use of conventional hydrocracking or fluid catalytic cracking. Distillates from coking of raw shale oil also require subsequent hydrotreating to remove residual impurities and meet final product specifications. In a 1977 test run in Chevron USA's Salt Lake Refinery, hydrotreating facilities were adequate; and stable products were produced by coking a mixture of in situ shale oil and crude oil residua. A pilot plant refining study on surface retorted Paraho shale oil was recently completed by Chevron Research Company under a US Department of Energy (DOE) contract. Three basic shale oil processing routes for the production of transportation fuels were studied: hydrotreating followed by hydrocracking, hydrotreating followed by fluid catalytic cracking (FCC), and severe coking followed by hydrotreating. Also, a fourth alternate was evaluated in which raw shale oil was hydrotreated to produce a synthetic crude suitable for processing in an existing refinery. In this paper, product yields, product properties, and estimated process costs derived from these studies are presented. It is concluded that shale oil can be refined to high quality transportation fuels via modern state-of-the-art refining technology and that it can serve as a substitute for crude oil in a refinery equipped with modern hydrotreating facilities.

PURIFICATION

REFER ALSO TO CITATION(S) 34542

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 34579, 35596, 35606

MARKETING AND ECONOMICS

34578 Oil shale symposium. Gibson, L. *Mines Mag.;* **70**: No. 6, 12-14(Jun 1980).

For the first time in the 60-year history of oil shale development in the United States, the estimated price of a barrel of shale oil is less than that being paid for a barrel of oil from conventional sources, and thus one of the major stumbling blocks to the still-fledgling industry has been removed. That was the consensus of speakers at the Colorado School of Mines 13th Oil Shale Symposium, who discussed technological, economic and social issues surrounding development of a commercial oil shale industry. Nobody suggested that the industry is ready to take off, however, despite the fact that economics has long been cited as a major reason for developers' hesitance in going ahead with commercial plans. The risks to successful commercialization of the industry are still sizeable. Among these are unreliable cost estimates for commercial-size plants, regulatory disincentives, uncertain future world oil prices, and possible cost overruns because of competition with other projects.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 35392, 35393

34579 (DOE/EV—0096) Issues and answers on the Department of Energy Oil Shale RD and D Program Management Plan. (Department of Energy, Washington, DC (USA). Assistant Secretary for Environment). Sep 1980. 175p. NTIS, PC A12/MF A01.

This document consists of Department of Energy replies to public comments made on the Department's Oil Shale RD and D Program and the RD and D Program Management Plan during an oil shale workshop held in December 1979 in Denver, Colorado, and incorporates responses from a number of Department offices and divisions currently associated with the Oil Shale Program. Workshop participants expressed concern in a number of areas associated with oil shale development impacts. Comments addressed effects on water quality and availability; air quality and solid waste impacts; impacts on terrestrial ecosystems; the pace of oil shale development; health, safety, and socioeconomic concerns; coordination among Federal, State, and local agencies during development of the shale resource; legislative and regulatory issues; financing of oil shale development; continued public education and involvement; and technology considerations (e.g., comments relating to shale oil upgrading, refining, product composition, and stability). Replies made by RD and D Program staff to the comments of workshop participants provide an overview of Department of Energy oil shale activities, both planned and ongoing, in the areas of concern addressed by the workshop. Although the responses focus on Department efforts to resolve these concerns, the research activities and responsibilities of other Federal agencies are also outlined. To supplement the RD and D Program response, recently published sources of information on oil shale development are identified that offer the public a more thorough description of Departmental research programs.

34580 (PB—80-102924) Lysimeter study on the disposal of Paraho retorted oil shale. Final report, July 1975-July 1978. Harbert, H.P. III; Berg, W.A.; McWhorter, D.B. (Colorado State Univ., Fort Collins (USA). Dept. of Agronomy). Aug 1979. 183p. NTIS, PC A09/MF A01.

This study used lysimeters to develop both a low-elevation (dry site) and a high-elevation (moist site) disposal scheme for Paraho (direct-heated) retorted shale. The objectives were to investigate: (1) vegetative stabilization of the surface of Paraho retorted shale and retorted shale covered with various soil depths; and (2) water and salt movement through both uncompacted and compacted Paraho retorted shale. The lysimeters were constructed in western Colorado in 1976 and filled in March 1977. Only a sparse vegetation cover (5% to 15) was established on retorted shale following fertilization, mulching, and irrigation. In contrast, adequate plant cover (55% to 85%) was established on the soil cover over retorted shale and on soil control treatment areas. Water balance calculations and drainage below the compacted zone indicated that water had moved into and through the compacted zone in the leached treatment areas. Further study is needed on the permeability of the compacted shale.

34581 (PNL-SA—7579) Analysis of Paraho oil shale products and effluents: an example of the multi-technique approach. Fruchter, J.S.; Wilkerson, C.L.; Evans, J.C.; Sanders, R.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 10 Jun 1979. Contract AC06-76RL01830. 25p. (CONF-790334—13). NTIS, PC A02/MF A01.

From Oil shale symposium; Denver, CO, USA (26 Mar 1979).

Inorganic analysis of solid, liquid and gaseous samples from the Paraho Semiworks Retort was completed using a multitechnique approach. The data were statistically analyzed to determine both the precision of each method and to see how closely the various techniques compared. The data were also used to determine the redistribution of 31 trace and major elements in the various effluents, including the offgas for the Paraho Retort operating in the direct mode. The computed mass balances show that approximately 1% or greater fractions of the As, Co, Hg, N, Ni, S and Se are released during retorting and redistributed to the product shale oil, retort water or product offgas. The fraction for these seven elements ranged from almost 1% for Co and Ni to 50 to 60% for Hg and N. Approximately 20% of the S and 5% of the As and Se are released. The mass balance redistribution during retorting for Al, Fe, Mg, V and Zn was observed to be no greater than .05%. These redistribution figures are generally in agreement with previous mass balance studies made for a limited number of elements on laboratory or smaller scale pilot retorts. 7 tables.

REGULATIONS

34582 (OTA-M—119) Assessment of oil shale technologies. Volume II: a history and analysis of the Federal Prototype Oil Shale Leasing Program. (Office of Technology Assessment (U.S. Congress), Washington, DC). Jul 1980. 89p. GPO.

This volume discusses the Federal Prototype Oil Shale Leasing Program that began in 1974 when the US Department of the Interior sold leases to four tracts in the oil shale regions of Colorado and Utah. A prior leasing attempt in 1968 is also described because it provides an historical perspective about the imperatives that have

encouraged the development of Federal oil shale lands by private industry and the restraints that have inhibited such development. The report includes discussions of political, economic, environmental, and energy-related factors that affected both the 1968 leasing attempt and its successor - the current Prototype Program. The Program's goals are identified, and its progress and status are examined to determine if those goals have been met or are likely to be met in the foreseeable future.

NUCLEAR FUELS

RESERVES

34583 (GJBX—162(80)) **Ritzville 1° x 2° NTMS area, Washington: data report.** Bennett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC13-76GJ01664. 64p. (DPST—80-146-3). NTIS, PC A04/MF A01.

This data report presents results of ground water and stream/surface sediment reconnaissance in the National Topographic Map Series (NTMS) Ritzville 1° x 2° quadrangle. Surface samples (sediment) were collected from 1063 sites. The target sampling density was one site per 20 square kilometers (eight square miles). Dry conditions contributed to the relatively small number (109) of surface water samples collected. Ground water samples were collected at 830 sites. Neutron activation analysis (NAA) results are given for uranium and 16 other elements in sediments, and for uranium and 9 other elements in ground water. Mass spectrometry results are given for helium in ground water. Field measurements and observations are reported for each site. Analytical data and field measurements are presented in tables and maps. Statistical summaries of data and a brief description of results are given. A generalized geologic map and a summary of the geology of the area are included. Data from ground water sites include: (1) water chemistry measurements (pH, conductivity, and alkalinity); (2) physical measurements where applicable (water temperature, well description, and scintillometer reading); and (3) elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from sediment sites include: (1) stream water chemistry measurements where applicable (pH, conductivity, and alkalinity); and (2) elemental analyses for sediment samples (U, Th, Hf, Al,Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors (stream characteristics, vegetation, etc.) are also tabulatd. Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th, U/Hf, and Th/La ratios; and scintillometer readings for sediment samples are included on the microfiche.

EXPLORATION

REFER ALSO TO CITATION(S) 35658

34584 (GJBX—165(80)) **Methods for obtaining distributions of uranium occurrence from estimates of geologic features.** Ford, C.E.; McLaren, R.A. (Oak Ridge National Lab., TN (USA)). Apr 1980. Contract AC13-76GJ01664. 109p. (K/CSD—13). NTIS, PC A06/MF A01.

The problem addressed in this paper is the determination of a quantitative estimate of a resource from estimates of fundamental variables which describe the resource. Due to uncertainty about the estimates, these basic variables are stochastic. The evaluation of random equations involving these variables is the core of the analysis process. The basic variables are originally described in terms of a low and a high percentile (the 5th and 95th, for example) and a central value (the mode, mean or median). The variable thus described is then generally assumed to be represented by a three-parameter lognormal distribution. Expressions involving these variables are evaluated by computing the first four central moments of the random functions (which are usually products and sums of variables). Stochastic independence is discussed. From the final set of moments a Pearson distribution is obtained; the high values of skewness and kurtosis resulting from uranium data require obtaining Pearson curves beyond those described in published tables. A cubic spline solution to the Pearson differential equation accomplishes this task. A sample problem is used to illustrate the application of the process; sensitivity to the estimated values of the basic variables is discussed. Appendices contain details of the methods and descriptions of computer programs.

34585 (GJBX—170(80)) **Uinta Arch Project: investigations of uranium potential in Precambrian X and older metasedimentary rocks in the Unita and Wasatch ranges, Utah and Colorado.** Graff, P.J.; Sears, J.W.; Holden, G.S. (Research Associates of Wyoming, Casper (USA)). Jun 1980. Contract AC13-76GJ01664. 297p. NTIS, PC A13/MF A01.

This study is part of the United States Department of Energy's National Uranium Resource Evaluation Program to understand the geologic setting, amount, and availability of uranium resources within the boundaries of the United States. The systematic study of Precambrian quartz-pebble conglomerates and areas that may contain such conglomerates is an integral part of DOE's resource evaluation program, because deposits of world-wide importance occur in such terrains in Canada and South Africa, and because terrains similar to those producing uranium from quartz-pebble conglomerates exist elsewhere in the United States. Because of the ready availability of Tertiary sandstone and Colorado Plateau-type uranium deposits, large areas of Precambrian rocks in the US have not been fully assessed for uranium potential. Thus, the Uinta Arch Project was undertaken to assess the favorability of Precambrian metasedimentary rocks in northern Utah for deposits of uranium in Precambrian quartz-pebble conglomerates. Rocks of interest to this study are the thick, clastic sequences within the Uinta Arch that are considered to be of Early Proterozoic age. The Uinta Arch area is known to contain rocks which generally fit the lithologic characteristics that are understood to limit the occurrence of Precambrian fossil placers. However, detailed geology of these rocks and their exact fit to the model described for uraniferous conglomerates was not known. The primary goal of the Uinta Arch Project was to determine how well these Precambrian rocks resemble known deposits and to describe the favorability of placer uranium deposits.

34586 (GJQ—002(80)) **National Uranium Resource Evaluation: Athens Quadrangle, Georgia and South Carolina.** Lee, C.H. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Sep 1979. Contract AC13-76GJ01664. 30p. NTIS, PC E02/MF $3.50.

Reconnaissance and detailed geologic and radiometric investigations were conducted throughout the Athens Quadrangle, Georgia and South Carolina, to evaluate the uranium favorability using National Uranium Resource Evaluation criteria. Surface and subsurface studies were augmented by aerial radiometric surveys, emanometry studies and hydrogeochemical and stream-sediment reconnaissance studies. The results of the investigations indicate environments favorable for allogenic deposits in metamorphic rocks adjacent to granite plutons, and Texas roll-type sandstone deposits in the Coastal Plain Province. Environments considered unfavorable for uranium deposits are the placers of the Monazite Belt, pegmatites, and base- and precious-metal veins associated with faults and shear zones in metamorphic rocks.

34587 (LA—8457-MS) **Overview of the National Uranium Resource Evaluation Hydrogeochemical and Stream Sediment Reconnaissance Program.** Bolivar, S.L. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01.

A Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) for uranium is currently being conducted throughout the conterminous United States and Alaska. The HSSR is part of the National Uranium Resource Evaluation sponsored by the US Department of Energy. This ambitious geochemical reconnaissance program is conducted by four Department of Energy Laboratories: Los Alamos Scientific Laboratory, Lawrence Livermore Laboratory, Oak Ridge Gaseous Diffusion Plant, and Savannah River Laboratory. Each laboratory was assigned a geographic region of the United States. The program is based on an extensive review of world literature, reconnaissance work done in other countries, and pilot studies conducted by each laboratory. Sample-collection methods and sample density are determined to optimize the probability of detecting potential uranium mineralization. To achieve this aim, each laboratory has developed independent standardized field collection procedures that are designed for its section of the country. Field parameters such as pH, conductivity, climate, geography, and geology are recorded at each site. Most areas are sampled at densities of one sample site per 10 to 23 km^2. The HSSR program has helped to improve existing hydrogeochemical reconnaissance exploration techniques. In addition to providing industry with data that may help to identify potential uranium districts and to extend known uranium provinces, the HSSR also provides multielement analytical data that can be used in water quality, soil, sediment, environmental, and base-metal exploration studies.

FEED PROCESSING

REFER ALSO TO CITATION(S) 35232

GASEOUS DIFFUSION

REFER ALSO TO CITATION(S) 34611

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 34932, 34933, 35236

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 34932, 34933, 35191, 35223, 35255

34588 Diversion resistance of a chloride volatility reprocessing system for UO_2/ThO_2 fuel. Bullard, J.E.; Petchul, J.J. (Lynchburg Research Center, VA). Contract 31-109-38-4183. *J. Am. Ceram. Soc.;* **63**: No. 7-8, 361-362(Jul 1980).

A chloride volatility process is considered for reprocessing ^{233}U-Th fuel. Isotopes of high gamma activity or neutron capture cross section are designated. The behavior of these isotopes in the process is related to their chemical states in the spent fuel, the free energies of reaction with Cl_2 and/or CCl_4, and the volatilities of the chlorides.

34589 (DOE/TIC—11263) **Facility design: introduction.** Unger, W.E. (Oak Ridge National Lab., TN (USA)). 11 Aug 1980. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

The design of shielded chemical processing facilities for handling plutonium is discussed. The TRU facility is considered in particular; its features for minimizing the escape of process materials are listed. 20 figures. (DLC)

34590 (DP-MS—80-9) **Voloxidation studies with UO_2 reactor fuels.** Stone, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 15p. (CONF-800943—4). NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Voloxidation was studied experimentally in small-scale laboratory tests with irradiated UO_2 reactor fuels. The present study developed new data on the effects on the voloxidation reaction of hull length, oxygen concentration, temperature, agitation, fuel density, and fuel type and burnup. The reaction was studied by measuring weight gains, yields of U_3O_8, product densities and particle-size distributions, reaction rates, tritium release, and behavior of other off-gases (^{14}C, ^{85}Kr, and ^{129}I).

34591 (PNL-SA—7752) **Krypton-85 storage in solid matrices.** Tingey, G.L.; McClanahan, E.D.; Bayne, M.A.; Gray, W.J.; Hinman, C.A. (Battelle Pacific Northwest Labs., Richland, WA (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 9p. (CONF-791112—67). NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Storage of Kr-85 will be required in support of nuclear power reactors beginning in 1983. Both approaches described here appear to meet the requirements for such a storage medium. Entrapment of the Kr during sputtering has several rather obvious safety advantages. The operation of the process at low rho and at or below room temperature should reduce markedly the potential for significant Kr-85 release to the environment during processing of the waste stream. It also appears that adaptation of this process for handling radioactive materials would also be simpler than the large high pressure, high temperature apparatus required for loading the glass sample. Furthermore, a significantly higher Kr loading is possible in the sputtered metals thus reducing the volume required for storage by as much as a factor of 50 to 100. On the other hand, the low density loaded glass process takes advantage of a very inexpensive starting material and existing commercial technology for high temperature, high pressure processes. The volume of the Kr-loaded glass matrix could be reduced by going to still higher pressures.

34592 (RHO-LD—79-3B) **Rockwell Hanford Operations process technology and process development. Semiannual report, April-September 1979.** (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jun 1980. Contract AC06-77RL01030. 145p. NTIS, PC A07/MF A01.

This semiannual report provides information on the technical progress of process technology and process development activities being performed by Research and Engineering, Rockwell Hanford Operations, to improve the processing of irradiated reactor fuels, the production of plutonium, and the management of resultant radioactive wastes. The work reported herein was performed during the period April 1979 through September 1979.

34593 Interphase transfer kinetics of uranium using the drop method, Lewis cell, and Kenics mixer. Horner, D.; Mailen, J.; Thiel, S.; Scott, T.; Yates, R. (Oak Ridge Natl Lab, Tenn). *Ind. Eng. Chem., Fundam.;* **19**: No. 1, 103-109(Feb 1980).

The rate constants for the interphase transfer of uranium between 3.5 M HNO/sub 3/ and tributyl phosphate (TBP)-normal hydrocarbon diluent solutions have been measured using the single drop method, Lewis cell method, and a Kenics mixer-centrifugal separator. Rate constants obtained by all methods were the same within experimental error. The variables studied that affect the rate constants include the TBP concentration, the acidity and total neutral nitrate concentrations of the aqueous phase, and temperature. Results of these tests indicate that the rate-controlling mechanism is chemical reaction at the interface. 12 refs.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 34610

34594 (AGNS—47921-3026-TPR-1) **Demonstrate fuel disassembly/encapsulation. Technical progress report, April 1980-June 1980.** (Allied-General Nuclear Services, Barnwell, SC (USA)). 25 Jul 1980. Contract AC09-79ET47921. 9p. NTIS, PC A02/MF A01.

Work on this project is focused on demonstrating disassembly and encapsulation of nuclear fuels as a means to increase spent fuel storage. The effort commenced on April 17, 1980, and is progressing satisfactorily. The Equipment/Procedure Preparation and Process Assessment Studies sub-tasks are currently underway with the Equipment Demonstration sub-task scheduled to commence February 1, 1981. The equipment design effort associated with the former sub-task and the technical studies and investigations associated with the latter sub-task continue to verify the feasibility of this concept to enhance the use of fuel storage resources.

34595 (AGNS—47921-TPR-4) **AFR Spent Fuel Storage Program. Technical progress report, April 1980-June 1980.** (Allied-General Nuclear Services, Barnwell, SC (USA)). 25 Jul 1980. Contract AC09-79ET47921. 11p. NTIS, PC A02/MF A01.

Work on this project is focused on developing design and licensing information for the model facility. The three major subcontracts for soils and structural design, rack design, and the security system design are progressing satisfactorily. Design modification work at AGNS is near completion. Licensing documentation is approximately 50% complete and progressing at a satisfactory pace to meet scheduled projections.

34596 (DOE/NE—0010) **Spent nuclear fuel: a comparison of at-reactor basin storage and away-from-reactor storage.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy). Jul 1980. 25p. NTIS, PC A02/MF A01.

A nuclear power reactor operator, confronted with rising spent fuel inventories that would soon exceed storage capacity, has several options to remedy this situation: transshipment, reracking of existing at-reactor storage basins (ARB), new ARB's, and away-from-reactor (AFR) basins. This report examines the latter two cases where a macro-economic comparison of each storage system is developed. The AFR storage system proved to be significantly more economical. This analysis indicates that 46 ARB's would be needed to meet storage requirements compared to only three AFR's. The total discounted costs associated with building new ARB's and AFR's are $4.7 billion and $1.2 billion respectively.

34597 (PNL-SA--7734) **Long-term leaching of irradiated spent fuel.** Katayama, Y.B.; Bradley, D.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 29p. (CONF-791112—68). NTIS, PC A03/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

Spent Light Water Reactor (LWR) fuel with burnups of 9, 28 and 54 MWd/kg U were leach tested at 25°C in deionized water in a Paige apparatus. No discernible differences in leach rates were observed due to burnup. Additionally, the 28 MWd/kg U fuel was IAEA leach tested in five different leachants using the IAEA method. Deionized water gave the highest leach rates and a calcium chloride solution gave the lowest leach rates. An accelerated leaching period was observed during the Paige leach test of the 54 MWd/kg U spent fuel. Comparison between spent fuel and borosilicate waste glass leach rates was made. In sodium bicarbonate solution the leach rates are near equal and the glass becomes increasingly more durable with $CaCl_2$ solution, followed by sodium chloride solution, WIPP B brine and deionized water where the glass is two to three orders of magnitude more leach resistant than spent fuel. 16 figures.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 34602

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 34592, 34597, 34933

WASTE PROCESSING

REFER ALSO TO CITATION(S) 34940, 35185

34598 (CONF-800802—11) **Melting metal waste for volume reduction and decontamination.** Copeland, G.L.; Heshmatpour, B.; Heestand, R.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Melt-slagging was investigated as a technique for volume reduction and decontamination of radioactively contaminated scrap metals. Experiments were conducted using several metals and slags in which the partitioning of the contaminant U or Pu to the slag was measured. Concentrations of U or Pu in the metal product of about 1 ppM were achieved for many metals. A volume reduction of 30:1 was achieved for a typical batch of mixed metal scrap. Additionally, the production of granular products was demonstrated with metal shot and crushed slag.

34599 (HEDL-SA—2064) **Combustible radioactive waste treatment by incineration and chemical digestion.** Stretz, L.A.; Crippen, M.D.; Allen, C.R. (Los Alamos Scientific Lab., NM (USA); Hanford Engineering Development Lab., Richland, WA (USA)). 28 May 1980. Contract W-7405-ENG-36;AC14-76FF02170. 60p. (CONF-800802—16). NTIS, PC A04/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

A review is given of present and planned combustible radioactive waste treatment systems in the US. Advantages and disadvantages of various systems are considered. Design waste streams are discussed in relation to waste composition, radioactive contaminants by amount and type, and special operating problems caused by the waste.

34600 (ORNL/TM—7427) **State-of-the-art report on low-level radioactive waste treatment.** Kibbey, A.H.; Godbee, H.W. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 155p. NTIS, PC A08/MF A01.

An attempt is made to identify the main sources of low-level radioactive wastes that are generated in the United States. To place the waste problem in perspective, rough estimates are given of the annual amounts of each generic type of waste that is generated. Most of the wet solid wastes arise from the cleanup of gaseous and liquid radioactive streams prior to discharge or recycle. The treatment of the process streams and the secondary wet solid wastes thus generated is described for each type of government or fuel cycle installation. Similarly, the institutional wet wastes are also described. The dry wastes from all sources have smilar physical and chemical characteristics in that they can be classified as compactible, noncompactible, combustible, noncombustible, or combinations thereof. The various treatment options for concentrated or solid wet wastes and for dry wastes are discussed. Among the dry-waste treatment methods are compaction, baling, and incineration, as well as chopping, cutting, and shredding. Organic materials can usually be incinerated or, in some cases, biodegraded. The filter sludges, spent resins, incinerator ashes, and concentrated liquids are usually solidified in cement, urea-formaldehyde, or unsaturated polyester resins prior to burial. Asphalt has not yet been used as a solidificaton agent in the United States, but it probably will be used in the near future. The treatment of radioactive medical and bioresearch wastes is described, but the waste from radiochenmical, pharmaceutical, and other industries is not well defined at the present time. Recovery of waste metals and treatment of hazardous contaminated wastes are discussed briefly. Some areas appearing to need more research, development, and demonstration are specifically pointed out.

34601 (PNL-SA—8085) **High level waste properties.** Turcotte, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract AC06-76RL01830. 36p. (CONF-7910184—1). NTIS, PC A03/MF A01.

From IAEA evaluation of solidified high level radioactive waste products workshop; Berlin, F.R. Germany (15 Oct 1979).

Devitrification and leaching analyses of four waste glasses were made to compare non-radioactive compositions to compositions made using fully radioactive waste calcine. Microstructural analyses of the phase behavior of glasses were performed by means of optical microscopy, x-ray diffraction, x-ray fluorescence, scanning electron microscopy, and electron microprobe analysis. The author's summary of the major findings are: Melt insoluables and crystallization products were found to the same extent in both radioactive and non-radioactive glasses of similar composition. High radiation field appeared to have no effect on the crystallization behavior. The results of long-term IAEA static leach tests indicated no significant difference between the average leach rates of the fully radioactive and non-radioactive glass formulations. Glass composition was more important in determining leach rates than was the extent of devitrification. In both short time tests at 75°C or longer leach tests at 25°C elemental analyses suggested that congruent dissolution did not occur.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 34591, 34765, 35247, 35447, 35659, 35660, 35663

34602 (RFP-Trans—286) **Management and disposal of wastes contaminated by alpha emitters.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [nd]. Translation of IAEA-SM—246/58. 10p. NTIS, PC A02/MF A01.

With the development of the French nuclear reactor program, the Public Authorities intensified their efforts toward disposal of wastes by establishing a central organization, ANDRA, on November 7, 1979. ANDRA has the responsibility for: assuring management of long-term storage centers; designing, laying out and constructing new long-term storage centers, and carrying out all the studies necessary for that purpose; promoting, together with the waste producers, specifications for fixation and storage of radioactive wastes before they are evacuated to the long-term storage centers; and contributing to the research, study and work concerning long-term storage of radioactive wastes as well as the future of such wastes. Through these processes of cooperation and exchanges, ANDRA regulates all the problems of wastes, and particularly the questions posed by alpha wastes. This paper goes on to elaborate on the following topics: definition of alpha waste; storage policy; regulations; specifications; inspection; methods of storage of alpha wastes; delivery provisions; management strategy; and economic aspects.

34603 **DOE program for the management of radioactive waste and spent reactor fuel.** Cooley, C.R. (US DOE, Washington, DC). *Therm. Power Conf. Proc.;* 165-181(1978). (CONF-7811153—).

From Thermal power conference; Pullman, WA, USA (8 Nov 1978).

The development of nuclear energy is seen by the Administration and the Department of Energy (DOE) as one of the important sources of energy for the country. Nuclear energy now provides a major fraction of the electrical power generation in some parts of the United States. In the northwest, with a wealth of hydroelectric power, nuclear power is expected to provide an increasing share of the total electrical energy. However, a great deal of public concern is being expressed about waste management associated with nuclear power. On current Research and Development programs, this paper considers several of the key activities which include work on disposal of spent fuel. 2 refs.

34604 (DOE/TIC—11260) **Social impact mitigation and nuclear waste repository siting.** Peelle, E. (Oak Ridge National Lab., TN (USA)). 26 Aug 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

Some aspects of the socioeconomic impacts of siting, constructing, and operating radioactive waste repositories in rural areas are discussed. These include public perceptions of high risk and uncertainty; limited benefits and no incentives; dissociations of costs and benefits; remoteness and inaccessibility of the decision making process for large energy facilities; no institutions to provide protection and accountability for those who may be affected by the siting; the fact that not all risks or impacts are fully mitigable; and constraints on DOE's present ability or authority to mitigate impacts. (DMC)

34605 (ONWI—91) **Potential US/Canadian cooperative activities in geological disposal of radioactive waste.** Duguid, J.O. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Mar 1980. Contract AC06-76RL01830. 43p. (TR—104). NTIS, PC A03/MF A01.

A joint review meeting between the US and Canada was held on June 19 and 20, 1979 to discuss waste isolation activities in crystalline rocks. The review meeting served the purposes of an initial information transfer and as a mechanism to stimulate thinking for a workshop on US/Canadian cooperative programs which was held on June 21, 1979. The workshop participants divided into working groups to discuss areas of potential cooperation: the Administrative Working Group established protocol for information exchange and cooperative activities; the Geotechnical Working Group selected activities in exploration, field testing, instrumentation and measurement technique development, monitoring, and quality assurance where cooperation would be of benefit to both countries; and the Assessment/Modeling Working Group discussed areas in model development and verification, engineered barriers, radiation effects, hydrologic properties of fractured rocks, waste form leaching, and sorption where cooperation would enhance both the US and Canadian programs.

34606 (ORNL/TM—7421) **Shale fracturing injections at Oak Ridge National Laboratory: 1977-1979 series.** Weeren, H.O. (Oak

Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 117p. NTIS, PC A06/MF A01.

Intermediate-level waste solution generated at ORNL is periodically mixed with a cement-base blend of dry solids and injected into an impermeable shale formation at an approximate depth of 240 m (800 ft). The grout mix sets shortly after the injection, permanently fixing the radionuclides in the shale formation. A series of four injections of intermediate-level waste solution was made between 1977 and 1979. A total of 1.2 million l (314,000 gal) of waste solution containing 81,780 Ci of radionuclides was injected. This report is an account of this injection series - preparations, injections, results, and conclusions. The volumes and activities that were injected are summarized. In Injection ILW-15 a small leak of grout to the waste pit eroded the drain valves and forced a shutdown of the injection while repairs were made. The injection was completed 2 days later. Injection ILW-16 was terminated about two-thirds through the injection when the diesel drive of the injection pump blew a connecting rod through the block. The facility and well were washed down with the standby pump. Prior to Injection ILW-17, air pads were installed on all bulk solids storage bins. All subsequent injections have been marked by a much more even flow of solids and a resulting improvement in the mix ratio control. Injections ILW-17 and ILW-18 were made without notable incidents. Logs of the observation wells indicated that all grout sheets were within the disposal zone.

34607 (RHO-CD—980) **Waste tank core drilling demonstration results.** DeFigh-Price, C. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1980. Contract AC06-77RL01030. 38p. NTIS, PC A03/MF A01.

In order to develop a strong data base and methodology for evaluating the structural integrity of the existing waste storage tanks, it is desirable to obtain concrete core samples from load bearing areas (the haunch, wall and footing) of actual waste tanks. The cores can be tested and compared with laboratory test data. Before cores are removed from the load bearing areas of an actual waste tank, it must be demonstrated that the drilling operation, including water control, can be safely performed. Two drilling tests were successfully completed in the 100-F Area during February and March 1980 demonstrating the feasibility of core drilling the wall of a 1 million gallon underground waste tank. This report summarizes the results of the demonstrations.

34608 (SAND—80-0467) **Numerical simulation of creep closure of deep potash mines (with application to waste isolation).** Munson, D.E.; Dawson, P.R. (Sandia Labs., Albuquerque, NM (USA); Cornell Univ., Ithaca, NY (USA). Dept. of Mechanical and Aerospace Engineering). Jul 1980. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01.

In this work, numerical simulation of the mechanical response of a deep mine opening in potash is shown to match measured room closures to within a factor of two. In this case, the calculated closure rates after eight years are within 25 to 75 percent of those measured. In making the calculations, a constitutive model for creep, as determined from laboratory triaxial tests of salt and short cylinder compressive tests of potash, was incorporated into a coupled thermal-mechanical fluid flow code, COUPLEFLO. The model is a multimechanism formulation of thermally activated processes acting in parallel. Because the field tests were well-documented, two-dimensional configurations and because the constitutive model was uniquely determined by laboratory data, the agreement between calculations and field data for these significant time durations is a first step in verification of the simulation technique. Application of the model and numerical methods presented here can be used to understand deformation in deep potash mines and, very importantly, to aid also in design of the waste isolation and petroleum storage facilities.

34609 (UCRL—15268) **State-of-the-art for evaluating the potential effects of erosion and deposition on a radioactive waste repository. Final report.** (Geotechnical Engineers, Inc., Winchester, MA (USA)). 16 Jul 1980. Contract W-7405-ENG-48. 64p. NTIS, PC A04/MF A01.

The potential impact of future geologic processes on the integrity of a deep, high-level radioactive-waste repository is evaluated. The following study identifies the potential consequences of surface erosion and deposition on sub-surface repository containment characteristics and assesses the ability to measure and predict quantitatively the rates and corresponding extent of these processes in the long term. Numerous studies of the magnitudes and rates of surficial erosion and deposition that have been used to determine the minimum allowable depth for a geologic repository (300 m - NRC Code of Federal Regulations, Part 60.122, Draft 10) are cited in this report. Measurement and interpretation of potential rates and extent of surficial processes in these studies involved considerable uncertainty, and the implications of this uncertainty on presently proposed repository siting criteria are addressed herein. Important concepts that should be considered when developing siting criteria to protect against deleterious effects arising from future erosion or deposition are highlighted. Erosion agents that could affect deep repositories are distinguished in this report so that their individual and combined impacts may be examined. This approach is recommended when evaluating potential repository sites in diverse environments that are susceptible to different agents of erosion. In contrast, agents of sedimentation are not differentiated in this report because of their relatively minor impact on a deep repository.

34610 (UCRL—84918) **Nuclear waste management: storage and disposal aspects.** Patterson, B.D.; Dave, S.A.; O'Connell, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 15p. (CONF-800904—2). NTIS, PC A02/MF A01.

From American Society of Civil Engineers specialty conference: civil engineering and nuclear power; Knoxville, TN, USA (15 Sep 1980).

Long-term disposal of nuclear wastes must resolve difficulties arising chiefly from the potential for contamination of the environment and the risk of misuse. Alternatives available for storage and disposal of wastes are examined in this overview paper. Guidelines and criteria which may govern in the development of methods of disposal are discussed.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 35436, 35448, 35470, 35536

34611 (KY—705) **Fixed bed trapping for gaseous fluoride effluent control.** Otey, M.G.; Bayne, C.K. (Paducah Gaseous Diffusion Plant, KY (USA)). 14 Jun 1980. Contract W-7405-ENG-26. 52p. NTIS, PC A04/MF A01.

To comply with future air quality standards for gaseous fluoride emissions at the PGDP, studies are being made to evaluate the most feasible and efficient method of trapping fluorides from the effluents of the different processes. Although this work is in direct support of environmental projects, its results are applicable in other areas. Throughout the diffusion plants there are several areas where fluorides, either single or multiple species, are controlled and/or processed. The solid sorbent studies represent new, promising technology which could have significant impact on the gaseous diffusion plants. Scoping studies of solid sorbents and reaction conditions have been conducted. In a series of statistically designed experiments, the effects of total gas flow, temperature, and fluoride gas flow were studied for eight dry chemicals in a 1-in. diameter fixed bed designed to remove three separate fluoride gas species [hydrogen fluoride (HF), fluorine (F_2), and chlorine trifluoride (ClF_3)] from an air stream. The trapping materials selected for the test include two brands of four different material types: soda lime, oolitic calcium carbonate ($CaCO_3$), calcium oxide (CaO), and activated alumina (Al_2O_3). Additionally, loading factors and material utilization were determined to allow an economic comparison to be made between bed materials.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 35382, 35527, 35546, 35547, 35548, 35549, 35552, 35553, 35556, 35557, 35558, 35559, 35560, 35561, 35562, 35563, 35564, 35565, 35566, 35567, 35568, 35569, 35570, 35571, 35572, 35573, 35574, 35575, 35576, 35577, 35578

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 34588, 34932, 34933, 35255

34612 (ANL—80-40, pp 305-336) **Part 7. Safeguards.** Amundson, P.I.; Rusch, G.K. Jul 1980.

In Fast Breeder Reactor studies.

This report describes fissile nuclear material safeguards technology, both current and developmental, and discusses the possible application of this technology to FBR systems. The proliferation risks associated with both subnational and national-level diversion are addressed.

34613 **Relaxation seen in nonproliferation policy.** Carter, L.J. *Science;* **206**: 32-34, 36(5 Oct 1979).

Two studies of the Nuclear Nonproliferation Act of 1978 as related to the future development of nuclear power (particularly breeder reactors) both in the US and other countries are reviewed. Both the Rowen-Wohlstetter study commissioned by the Department of Energy, the National Security Council, and the Council on Environmental Quality and the Ford Foundation sponsored report reinforce the opposing sides of the debate. The Rowen-Wohlstetter report argues strongly against the apparent relaxation of the US

position on nonproliferation, while the Ford Foundation report maintains that a policy of denial of nulcear technology is mistaken and counter-productive. It is pointed out that the basic energy needs of any country will probably finally decide its stand on the use of breeder reactors if the technology is available to all people and that there is no real assurance that breeder technology for power cannot be diverted to weapon technology, i.e. India produced a bomb in 1974. (BLM)

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 35437

34614 (DOE/NE—0007(Supp.1)) **Proposed rulemaking on the storage and disposal of nuclear waste. Cross-statement of the United States Department of Energy.** (Department of Energy, Washington, DC (USA)). 5 Sep 1980. 298p. NTIS, PC A13/MF A01.

The US DOE cross-statement in the matter of proposed rulemaking in the storage and disposal of nuclear wastes is presented. It is concluded from evidence contained in the document that: (1) spent fuel can be disposed of in a manner that is safe and environmentally acceptable; (2) present plans for establishing geological repositories are an effective and reasonable means of disposal; (3) spent nuclear fuel from licensed facilities can be stored in a safe and environmentally acceptable manner on-site or off-site until disposal facilities are ready; (4) sufficient additional storage capacity for spent fuel will be established; and (5) the disposal and interim storage systems for spent nuclear fuel will be integrated into an acceptable operating system. It was recommended that the commission should promulgate a rule providing that the safety and environmental implications of spent nuclear fuel remaining on site after the anticipated expiration of the facility licenses involved need not be considered in individual facility licensing proceedings. A prompt finding of confidence in the nuclear waste disposal and storage area by the commission is also recommeded. (DMC)

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

34615 (SAND—80-1955C) **Metal loaded poly-p-xylene.** Bieg, K.W. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 5p. (CONF-801037—3). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Inertial confinement fusion target designs frequently require hydrocarbon polymer coatings loaded with varying amounts of high atomic number materials, typically metals. In addition to the usual requirements on thickness uniformity and surface finish, the metal loading must be dispersed in the polymer matrix on a submicron scale. The common means of obtaining such coatings for laser fusion targets is by glow discharge polymerization of an appropriate organometallic monomer starting material. Particle beam fusion targets, on the other hand, have utilized polymer coatings obtained by the pyrolytic vapor deposition of p-xylene. With this process, one may obtain halogenated poly-p-xylene by synthesis of the required halogenated dimer. Alternatively, we are developing a technique to incorporate metals into poly-p-xylene, essentially by combining the reactive monomer vapor, downstream from the pyrolysis region, with metal vapor from a resistively-heated source in a vacuum chamber. In addition to allowing the possibility of codeposition with any material which can be deposited by thermal evaporation, the technique allows for graded composition/density within the coating. In principle, one can obtain films with metal loadings continuously variable from that of the poly-p-xylene matrix through solid metal density.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

RADIATION SOURCES

OTHER INDUSTRIAL USES

34616 (CONF-800964—1) **Cesium-137 source material for an irradiator.** Lamb, E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From National symposium on the use of cesium-137 to process sludge for further reduction of pathogens; Denver, CO, USA (3 Sep 1980).

The feasibility of using ^{137}Cs for the gamma source in sludge irradiators is discussed. It was concluded that ^{137}Cs, because of its availability in large quantities as a by-product of fission in nuclear reactors, is an excellent candidate source for use in sewage sludge irradiators. The capsules used to store $^{137}CsCl$ in the Waste Encapsulation and Storage Facility embody the technology gained by extensive development and experience during the past 25 years. The WESF capsule provides a rugged, well-proved containment of $^{137}CsCl$ that has been shown to be resistant to a series of unusual stresses.

ISOTOPIC POWER SUPPLIES

34617 (PNL—3433) **Compatibility testing of the WESF $^{90}SrF_2$ storage capsule at 800°C.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 21p. NTIS, PC A02/MF A01.

A program is currently under way at Pacific Northwest Laboratory to develop the information needed to permit the licensing of $^{90}SrF_2$ as a radioisotope heat-source fuel for terrestrial application. A major portion of the effort is directed at determining the compatibility of $^{90}SrF_2$ with containment materials at anticipated heat-source operating temperatures. One phase of the compatibility studies involved the testing of two WESF $^{90}SrF_2$ storage capsules at approximately 800°C. The first capsule was tested for 5000 h and the second for 26,200 h. The capsules were placed in individual insulated containers and allowed to self-heat to the test temperature. The tests were conducted in a hot cell at WESF. Heat losses from the insulated containers were uneven, and as a result a temperature gradient existed between the center and ends of each capsule. In the 5000-h test the metal/$^{90}SrF_2$ interface temperature varied from about 730 to 821°C; in the 26,200-h test the temperature varied from about 750 to 831°C. Metallographic examination of sections of metal taken from the Hastelloy C-276 capsules showed that chemical attack of the metal was not significantly greater in the 26,200-h test than in the 5000-h test. Similar results have been observed in other compatibility tests involving Hastelloy C-276 and $^{90}SrF_2$. The data indicate that chemical attack of the Hastelloy C-276 is due to impurities in the strontium fluoride, and that once the impurities are consumed the rate of attack drops to a very low level.

HYDROGEN

PRODUCTION

34618 (TAC-H—80-002) **Hydrogen Energy: a bibliography with abstracts. Quarterly update, April-June 1980.** Srinivasan, R. (ed.). (New Mexico Univ., Albuquerque (USA). Technology Application Center). Aug 1980. 111p. Univ. of New Mexico, Technology Application Center, Albuquerque.

This bibliography contains 296 citations on the subject of hydrogen as a secondary fuel and energy carrier. Production, utilization, transmission, distribution, storage, safety, and materials are covered.

THERMOCHEMICAL PROCESSES

34619 (LASL—80-26) **Thermochemical cycles. A new method of producing hydrogen.** Cox, K.E. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01.

Many approaches, all designed to produce hydrogen rapidly, have been tried. The effects of catalysts, organic solvents, complexing agents, and molten salts are being investigated, and they contribute to the basic understanding of thermochemical cycles for hydrogen production. Recently, this work has been broadened to include reactions in the temperature range of 1000 to 2000°C (1800 to 3600°F), which may be available from sources such as high-temperature solar collectors or future fusion machines.

STEAM REFORMER PROCESSES

REFER ALSO TO CITATION(S) 35061

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 34668, 34669, 34674

STORAGE

REFER ALSO TO CITATION(S) 34618

TRANSPORT

REFER ALSO TO CITATION(S) 34618

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 34618

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 34621

34620 New Zealand methanol-to-gasoline process can be based on coal. *Oil Gas J.*; **78**: No. 2, 95-96(14 Jan 1980).

A brief account is given of how natural gas will be converted into synthetic gasoline in New Zealand by application of a Mobil process which converts methanol directly into high-octane gasoline. The methanol can be made either from natural gas, as will be done in New Zealand, or from coal by commercially proven technology. The key component in this process is a shape-selective catalyst that can quantitatively convert methanol to hydrocarbons with a high selectivity for high-octane gasoline.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 34666

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 35135

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 34620

34621 (DOE/ER/10345—1) **Mechanistic studies of carbon monoxide reduction. Progress report, August 1, 1979-August 1, 1980.** Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA)). 29 Jul 1980. Contract AC02-79ER10345. 16p. NTIS, PC A02/MF A01.

Mechanistic schemes for the metal surface catalyzed reduction of carbon monoxide to methanol and hydrocarbons have been proposed and the feasibility of these mechanisms are being tested by preparing and studying the chemistry of metal clusters which resemble the proposed surface intermediates. In an effort to prepare clusters with bound formyl groups, $Os_3(CO)_{12}$ and $IR_4(CO)_{12}$ have been treated with $Li[BH(O\text{-}i\text{-}Pr)_3]$. Evidence for a formyl intermediate has been obtained with $Os_3(CO)_{12}$, and upon acidification of solutions containing this species, the new cluster $Os_3(CO)_{11}CH_2$ is isolated. The CH_2 group derives by the stepwise reduction of CO, and experiments directed toward delineating the mechanism of this transformation are described. Treatment of $Os_3(CO)_{11}CH_2$ with H_2 at 70 to 80°C yields CH_4, and thus the complete stoichiometric conversion of CO to CH_4 has been achieved on an Os_3 cluster. The new clusters [PPN] $[HFeRu_3(CO)_{13}]$ and [PPN]$[HFe_2Ru_2(CO)_{13}]$ ($PPN^+ = (Ph_3P)_2N^+$) have been prepared in an attempt to prepare analogs of $[HFe_4(CO)_{13}]^-$ which possesses an unusually bound and presumable activated CO. The crystal structures of each of these new clusters have revealed no unusual CO bonding modes and instead they adopt structures with pseudo-tetrahedral metal frameworks. Several reactions have been conducted directed toward the preparation of alkyl and acyl substituted clusters and these are described. The reaction of a series of mixed-metal clusters with CO have been studied. Each readily fragments under a CO atmosphere and for $H_2FeRu_3(CO)_{13}$ the rate and mechanism of this reaction have been determined.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 34658, 34662

34622 Alcohol fuels--energy savior or wastrel?. Jenkins, D.M. (Battelle, Columbus Lab, Ohio). *Proc., Am. Pet. Inst., Refin. Dept.*; **58**: 41-47(1979). (CONF-7905163—).

From 44. American Petroleum Institute refining department midyear meeting; San Francisco, CA, USA (14 May 1979).

The net energy requirements of several processes to manufacture alcohol have been investigated. The processes include ethanol from sugarcane, ethanol from corn, ethanol from corn stover, and methanol from wood. Fuel required for growing the feedstock and for processing to alcohol fuels is considered. Along with total net energy consumption, potential savings of petroleum are discussed. Ethanol from sugarcane and methanol from wood are net energy producers while ethanol from corn and from corn stover are net energy consumers. The energy consumed in the manufacture of 1 Btu ethanol was estimated at 0.3 Btu from sugarcane, 1.2 Btu from corn, and 1.5 Btu from corn stover. Methanol from wood consumes about 0.45 Btu per Btu product. All processes considered consume less energy than coal liquefaction, and all can be net producers of liquid fuel if coal is used to generate process heat and electricity. 3 refs.

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 35101, 35283

34623 (PB—80-123425) **Trico wood waste study.** (Trico Economic Development District, Colville, WA (USA)). Nov 1979. 80p. NTIS, PC A05/MF A01.

The lumber industry of Northeast Washington has produced wood residue which has been unused and wasted. The purpose of the report is to determine the amount of wood residue available. The study concentrates on logging residue and Timber Stand Improvement, using information from Washington State University's study on weight and heat values of Northeast Washington trees. At the present time however, there are still significant quantities of unused mill residue. If the wood fired generating plant proposed by Washington Water Power is constructed, it is anticipated all available unused mill residue would be consumed.

HYDRO ENERGY

RESOURCES AND AVAILABILITY

34624 (UCID—18772) **Small hydroelectric power development in China.** Skidmore, F.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01.

The small hydroelectric development in China is extensive, with more than 90,000 units, but represents a very small resource in terms of total electricity generation (or as little as 4%). In the rural areas, however, small hydro is an important tool for modernization and represents a substantial percentage (30%) of the electricity. Its characteristics - simplicity, reliability, and low cost are ideal for isolated underdeveloped areas. Good turbine design is largely an empirical science. The Chinese experience in developing technology for for a large variety of operating conditions has provided an empirical basis for good designs. Their small turbines and accompanying control mechanisms thus appear to be competitive in the American market. It is not obvious that other technology, especially on the electrical side, has advantages for the American market. It appears that the Chinese emphasis on small hydroelectric development, in parallel with large central development, will continue in the future. Technical development, especially in the small standardized turbine area, should continue as well.

POWER CONVERSION SYSTEMS

34625 (PB—80-116759) **An electric conversion for mechanical-hydraulic governors of water wheel turbines.** Clemans, C.L.; Eilts, L.E.; Schleif, F.R. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). Dec 1979. 45p. NTIS, PC A03/MF A01.

A conversion system for upgrading performance of conventional mechanical governors for hydraulic turbines has been developed. The conversion retains the proven long-term stability of the ball head speed reference but replaces the dashpot function with

erivative terms from an independent frequency sensor. The result upgrades the governor system from temporary-droop type to a higher order double-derivative type. Installation is simple. All original mechanical apparatus is retained for startup and standby; control can be transferred instantly. The advantages are a higher sensitivity to small system speed deviations and faster, smoother response to system load control.

SOLAR ENERGY

REFER ALSO TO CITATION(S) 35017, 35054, 35055, 35056

34626 (PB—80-804099) **Solar distillation (citations from the Engineering Index data base). Report for 1970-January 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 124p. NTIS PC N01/MF N01.

Feasibility, design, and construction of solar stills are discussed in abstracts of reports from worldwide literature. Most abstracts deal with the construction of solar stills for the desalination of sea water; a few abstracts pertain to thermodynamic analyses, agricultural uses, and providing potable water for isolated residences of small communities. Experience with the use of solar stills in various countries is covered. (This updated bibliography contains 117 abstracts, 23 of which are new entries to the previous edition.)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 34692, 34727, 34851, 34852, 34853, 34854, 34855, 34856, 34857, 34858, 34859, 34860, 34861, 34862, 34863

34627 (AD-A—078368/8) **A new model for sky cover. Scientific rept no. 5, 1 sep 78-27 aug 79.** Somerville, P.N.; Bean, S.J. (University of Central Florida, Orlando (USA). Dept. of Mathematics and Statistics). 27 Aug 1979. Contract F19628-77-C-0080. 37p. NTIS, PC AA03/MF A01.

The S-distribution, which has a closed form cumulative distribution function is used to model sky cover. Models are developed for 23 stations distributed throughout the world, one for each month and for each three-hour period of the day. Estimates of the amounts of error in using the model to predict cloud cover less than a stated amount are given. (Author)

34628 (AD-A—078660/8) **Guide to standard weather summaries and climatic services. Reference report.** Ownbey, J.W. (Naval Air Systems Command, Washington, DC (USA)). Jan 1980. 209p. NTIS, PC AA10/MF A01.

This report provides a description of published and unpublished climatological summaries available from the climatic complex in Asheville, NC. It also includes a catalogue of the available summaries on a world-wide basis in continent-country-station order. (Author)

34629 (NP—25081) **Solar radiation on inclined surfaces.** (Tata Energy Research Inst., Bombay (India)). May 1980. 82p. NTIS, PC A05/MF A01.

Mean monthly values of daily shortwave radiation on inclined surfaces are presented for 13 locations in India. Values of direct, diffuse sky, reflected, and total shortwave radiation incident on an inclined surface are given for 9 slope angles (measured from the horizontal) and 8 aspects. All the data are computed using measured values of the total shortwave radiation on a horizontal surface according to the techniques described. The horizontal slope (0°) is omitted since values of radiation on such a surface are obviously independent of aspect and such values are available in the IMB publication entitled Radiation Short Period Averages. Aspects of 0, -90, +90, and 180 are south-, east-, west-, and north-facing respectively. The data are expressed in energy units, i.e., MJ m^{-} day^{-1}. Maximum and minimum values of direct solar radiation during each month are underlined and marked by asterisk respectively. Actual and potential users of radiation data, particularly those in the fields of agriculture, horticulture, forestry, architecture, heating and ventilating engineering, and photovoltaic systems, it is hoped, would find this publication useful in planning and designing of solar radiation devices.

34630 **Accuracies achievable with indirect measurements of the direct solar irradiance component.** Secrest, J.A.; Dirmhirn, I. (Utah State Univ, Logan). *Sol. Energy;* **23**: No. 6, 509-512(1979).

Calculated direct solar irradiances from recording of global and diffuse irradiance are analyzed. To achieve the desired accuracy of 2 per cent of direct solar irradiance, corrections for the cosine error of the pyranometer to measure global irradiance and of the error induced by the shadowband in the diffuse irradiance have to be applied. Results then are satisfactory to zenith angles of approx. 80°. Data for the global and diffuse irradiances were received from start type black and white pyranometers (Schenk). For the diffuse irradiance, a fixed shadowband was used that can be moved along two bars according to the declination of the sun. 2 refs.

ECONOMICS

REFER ALSO TO CITATION(S) 34632

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 35065, 35608, 35638, 35639

34631 (DOE/ER—0072) **Prototype environmental assessment of the impacts of siting and constructing a Satellite Power System (SPS) Ground Receiving Station (GRS).** (Environmental Resources Group, Los Angeles, CA (USA)). Aug 1980. Contract W-31-109-ENG-38. 272p. NTIS, PC A12/MF A01.

This report is a prototype assessment of the environmental and societal impacts of a Satellite Power System (SPS) Ground Receiving Station (GRS). (The term GRS here refers to the overall facility that includes the rectenna, which actually receives and rectifies the microwave energy, as well as support facilities, access roads, a buffer zone, etc. in addition to the rectenna itself.) The study objectives are: (1) to develop a comprehensive prototype assessment of the non-microwave-related impacts (microwave health and safety and communications effects, etc. are not addressed) on the natural and human environments of the reference system SPS GRS; (2) to assess the impacts of GRS construction and operations in the context of actual baseline data for a site in the California desert (about 250 kilometers north of Los Angeles) which, while it has not been selected as eligible for GRS siting, has many features that are optimal for SPS; and (3) to identify critical GRS characteristics or parameters that are most significant in terms of both the natural and human environment. Critical project parameters revealed include: the sheer size and intensity of use of the contiguous land area required by an SPS GRS; the lack of flexibility in siting individual rectenna structures once the rectenna boundaries are established; the difficulties in finding suitable sites that do not conflict with other societal needs and values; uncertainties relating to reestablishing native ecosystems following total ecosystem modification during construction, and the related need for further research into microclimatic effects near the ground-surface beneath the rectenna panels.

34632 (SERI/CP—741-683) **Open workshop on solar technologies. Proceedings.** (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 231p. (CONF-7910187—). NTIS, PC A11/MF A01.

From Open workshop on solar technologies; Washington, DC, USA (23 Oct 1979).

The deliberations, conclusions, and recommendations of six panels asked to provide advice to the Department of Energy on the subject of solar energy are detailed. Approximately 60 invited panelists and 120 observers met in three panels devoted to Solar Energy and Cities and three panels on Solar Energy and Employment. The day-and-one-half meeting occurred at the Department of Energy's Forrestal Building headquarters in Washington, DC, on 23 and 24 October 1979. Introductory speeches by seven experts, excerpts from the succeeding two half-days of discussion, the final reports for the panel chairpersons, and subsequent discussion and questioning are included. Approximately 125 findings and recommendations were developed by the six panels covering a wide variety of topics. Major recurring themes were recommendations for increased funding, federal program improvement, conservation, outreach programs, small business funding, and solar training programs. Detailed responses from the Department of Energy have been prepared for all recommendations and are contained in a companion volume.

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 35179

34633 (CONF-800544—2) **Ion implanted and laser processed solar cells made from EFG ribbon.** Ladd, L.A.; Ravi, K.V.; Narayan, J. (Mobil Tyco Solar Energy Corp., Waltham, MA (USA); Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From Electrochemical Society meeting; St Louis, MO, USA (11 May 1980).

The use of ion implantation and laser processing has a number of conceptual advantages which could result in a low-cost process for manufacturing high performance solar cells from EFG ribbon. Samples were phosphorus ion implanted, laser processed using either a pulse large area ruby laser or a scanned YAG laser with a second harmonic generator, and then processed into solar cells. Many of the samples had high reverse leakage and it was determined that this was due to too high a laser processing power. This effect was determined to be more severe for the scanned YAG laser, and is thought to be due to point defects. Cells were made from EFG ribbon with a low laser energy density which had efficiencies of up to 10% at AMI demonstrating the feasibility of this approach. High efficiencies should be attainable by optimizing the laser processing parameters.

34634 (DOE/ET—23108-3) **Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells.** Redfield, D. (RCA Labs., Princeton, NJ (USA)). Feb 1980. Contract AC01-79ET23108. 36p. NTIS, PC A03/MF A01.

Fundamental limitations on the performance of Si solar cells are shown to be quite different from those that have been conventionally invoked. Particularly for heavy-doping effects, the usual models are shown to be invalid and a new method is devised for calculating the reverse saturation current of a heavily doped device in which nearly all minority carriers reach the junction (viz., good blue-response). Calculations by the new method show: (1) increased doping above $10^{18}cm^{-3}$ does not improve the open-circuit voltage as has been thought, and (2) previous estimates of bandgap varrowing in diffused cells are much too high because of the neglect of Auger recombination effects. Also of importance are the effects of doping gradients and their relation to the properties of the front surface of a diffused-junction cell; experiments are clarifying some of these relations. These experiments have led to a new, simple method of separating the internal optoelectronic properties of a solar cell (or optical detector) from the reflectance properties of the front surface. This method thus provides a direct means of evaluating the effectiveness of antireflection coatings on such devices.

34635 (DOE/ET/23013—T5) **Controlled cadmium telluride thin films for solar cell applications (emerging materials systems for solar cell applications). Final technical report, April 9, 1979-April 8, 1980.** Vedam, K.; Das, M.B.; Krishnaswamy, S.V. (Pennsylvania State Univ., University Park (USA)). Jun 1980. Contract AC02-79ET23013. 41p. NTIS, PC A03/MF A01.

After a brief review of the work done during the first three quarters, the work done during the last quarter is discussed in detail. In brief, CdTe sputtered self-doped and indium-doped n-type layers on Ni-film on glass have been investigated for film resistivity, contact resistance, Hall mobility and Schottky barrier diode characteristics. Ni has been found to provide satisfactory ohmic contacts and self-doped samples have indicated Hall mobility of approximately $8cm^2/Vsec$ when the effective doping concentration is approximately $10^{18}cm^{-3}$. Use of indium doped sputtered films, when properly surface treated prior to metallization, appear to yield the best kind of Schottky barrier diode with approximate barrier height of 0.77 volt and Richardson constant $A^* \simeq 60\ A/cm^{20}K^2$. In spite of these attractive parameter values, these devices showed low V/sub oc/ and the capacitance showed unexpected frequency dependence that require further investigation. Finally suggestions for future work is presented.

34636 (DOE/ET/23048—T1) **Low cost thin film polycrystalline silicon solar cells. Final report, March 15, 1979-July 31, 1980.** (Poly Solar, Inc., Garland, TX (USA)). Jul 1980. Contract AC03-79ET23048. 48p. NTIS, PC A03/MF A01.

The objective of this contract is to advance the thin film silicon solar cell technology with a view toward achieving photovoltaic conversion efficiencies greater than 10% at a cost of $100 to $300/kWe. The technical approaches consist of (1) the purification of metallurgical silicon by acid extraction and gettering techniques, (2) the preparation of metallurgical silicon substrates by the unidirectional solidification of the melt on graphite, (3) the deposition of a silicon p-n junction structure on metallurgical silicon substrates by the trichlorosilane process, and (4) the application of grid contacts and anti-reflection coatings. Major efforts were directed to the scale-up and optimization of all processing steps. The purification of metallurgical silicon by acid-extraction and phosphorus ntoxide treatment has been studied in detail. The minimum iron concentration obtainable is about 500 ppMa by the acid-extraction technique and is about 200 ppMa by the gettering technique. A standard procedure has been developed for the acid-extraction of metallurgical silicon, however, considerable difficulties have been encountered in the large-scale gettering process. Metallurgical silicon substrates have been prepared from the unidirectional solidification of the melt on graphite by the stationary and moving coil techniques. Many large area solar cells have been prepared from acid-extracted metallurgical silicon substrates by depositing the active region using the trichlorosilane process. The best cells ($32\ cm^2$) have AM1 efficiencies of about 7.7%, and their photovoltaic properties have been characterized.

34637 (DOE/ET/23108—4) **Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Quarterly report No. 3, February 1-April 30, 1980.** Redfield, D. (RCA Labs., Princeton, NJ (USA)). May 1980. Contract AC01-79ET23108. 21p. NTIS, PC A02/MF A01.

In the area of heavy-doping effects there are two significant recent developments. One concerns J_0 the saturation current density of shallow p-n junctions in which essentially all minority carriers generated are collected by the junction (e.g., solar cells with good blue-response). It is shown that for such cases J_0 is proportional to the junction depth. The second result concerns the role of Auger recombination in n-type bases of solar cells. It is shown that, as in p-type bases, the reduction in I/sub sc/ caused by heavy doping is explained by Auger recombination that becomes apparent at densities of $10^{18}cm^{-3}$. Increased work in the modeling of electrical properties of grain boundaries appears to have opened a new path to understanding a number of observations of these properties. On the basis of several types of measurements and the reports of others in the field, it is shown that a quasi-surface model for the electrical properties describes the boundaries much better than does the crystallographic-misorientation model. Attempts to extend the application of the quasi-surface model in a semiquantitative way provide unexpectedly good agreement with observations of smaller barriers in p-type material than in n-type. Among the consequences of this model is the conclusion that DLTS has a low probability of successful application in the study of electronic states at grain boundaries in p-type Si from which most polycrystalline thin-film solar cells are made.

34638 (DOE/JPL/954334—80/15) **Low-Cost Solar-Array Project. Quarterly progress report, April-June 1980.** (Union Carbide Corp., Sistersville, WV (USA)). 1980. Contract NAS-7-100-954334. 181p. NTIS, PC A09/MF A01.

The overall objective of the LSA Silicon Material Task is to establish a chemical process for producing silicon at a rate and price commensurate with the production goals of the LSA project for solar-cell modules. As part of the overall Silicon Material Task, Union Carbide developed the silane-silicon process and advanced the technology to the point where it has a definite potential for providing high-purity polysilicon on a commercial scale at a price of $14/kg by 1986 (1980 dollars). This work, completed under Phases I and II of the contract, provided a firm base for the Phase III Program (initiated in April 1979) aimed at establishing the practicality of the process by pursuing the following specific objectives: (1) design, fabricate, install, and operate an Experimental Process System Development Unit (EPSDU) sized for 100 MT/yr to obtain extensive performance data to establish the data base for the design of commercial facilities; (2) perform support research and development to provide an information base usable for the EPSDU and for technological design and economic analysis for potential scale-up of the process; and (3) perform iterative economic analyses of the estimated product cost for the production of semiconductor-grade silicon in a facility capable of producing 1000 MT/yr. This process for preparing semiconductor-grade silicon in the EPSDU from metallurgical-grade (M-G) silicon is based on a well-integrated arrangement of purification steps that provides a cost-effective process system. The three basic steps entail converting M-G silicon to trichlorosilane, redistributing the trichlorosilane to produce silane, and thermally decomposing the silane to form amorphous silicon powder. The powder is then melted and the molten silicon is cast to polycrystalline for subsequent use in fabricating solar cells. Progress is reported in detail. (WHK)

34639 (DOE/JPL/954373—80/14) **Silicon ingot casting: Heat Exchanger Method (HEM)/multi-wire slicing: Fixed Abrasive Slicing Technique (FAST), Phase IV. Quarterly progress report No. 2, April 1, 1980-June 30, 1980.** Schmid, F.; Khattak, C.P.; Basaran, M. (Crystal Systems, Inc., Salem, MA (USA)). Aug 1980. Contract NAS-7-100-954373. 46p. NTIS, PC A03/MF A01.

Silicon ingot size cast by HEM has been extended to 34 cm x 34 cm x 10 cm. A 20 kg ingot has been solidified at 3 kg/hr with no crucible attachment or ingot cracking problems. Another ingot of 26 kg weight has also been solidified. The heat treatment used to develop a graded structure caused cracking on the inside surface of the first large crucibles. The thermal conditions were altered to minimize high gradients and the cracking was eliminated. A high degree of single crystallinity has been maintained as the size of the ingots has been increased. A graphite retainer made out of flat plates was used to produce an ingot with flat sides and rounded curves. It is now possible to electroplate diamonds only on the cutting edge of the wire. The advantages associated with diamonds on the cutting edge only are lower kerf, improved accuracy by improved seating in the support rollers, and less degradation of the rollers. This has resulted in less wander of wires and will reduce costs by using less diamonds and less degradation of rollers. The main failure mechanism of wires - diamond pullout - has been minimized by using filler diamonds to prevent erosion of the nickel matrix. It has been shown that an electroplated wirepack can be used to slice three 10 cm

diameter silicon ingots without significant diamond pullout. IPEG analysis of value added costs of sheet formation using conservative and optimistic extension of HEM and FAST technologies yields $27.05/m² ($0.191/w) and $13.49/m² (0.095/w), respectively. Assuming cost goals of other tasks are met, the projected costs are $0.654/w, conservatively, and $0.539/w, optimistically, for photovoltaic modules.

34640 (DOE/JPL/954521—80/14) **Integral glass encapsulation for solar arrays. Quarterly progress report No. 14.** (Spire Corp., Bedford, MA (USA)). Aug 1980. Contract NAS-7-100-954521. 13p. NTIS, PC A02/MF A01.

This is the fourteenth quarterly report under a JPL/DOE program to develop electrostatic bonding as a method of integral encapsulation of solar cells in glass. Efforts for the current phase of this program are to continue demonstrations of process uniformity of electrostatic bonding encapsulation by production of 24-cell minimodules by ESB. Additional goals of this program are to develop preformed (wire-mesh) contacts as a method of integrating cell processing into the encapsulation procedure, resulting in a low-cost module assembly technique, and to investigate low-temperature bonding to commercially available glass (Pyrex) superstrates. Progress is reported.

34641 (DOE/JPL/955624—80/1) **Silicon dendritic web material process development. First quarterly report, March 28-June 30, 1980.** Campbell, R.B.; Stapleton, R.E.; Sienkiewicz, L.; Rai-Choudhury, P. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 1980. Contract NAS-7-100-955624. 37p. NTIS, PC A03/MF A01.

Initial values of pressure, power, and speed have been determined for seam bonding interconnects to dendritic web solar cells. Satisfactory bond strengths and high yield have been achieved without cell damage. However, in case of processing large numbers of cells for module fabrication, further testing is required to assure reproducibility of this technique. Various techniques have been developed for fabricating solar modules by lamination using ethylene vinyl acetate with a glass superstrate, and no cell breakage has been noted.

34642 (DOE/SERI—8229-3/2-T6) **Sequential purification and crystal growth for the production of low cost silicon substrates. Quarterly technical progress report No. 3, 1 April-30 June 1980.** Liaw, M.; Secco D'Aragona, F. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). Aug 1980. Contract AC02-77CH00178. 32p. NTIS, PC A03/MF A01.

The objective of this program is to identify and develop low cost processing for fabricating large grain size polycrystalline silicon substrates. Metallurgical grade silicon (MG-Si) is chosen as the starting material for sequential purification and crystal growth. Several purification techniques have been studied. They include (1) acid leaching with HCl, (2) physical separation of insoluble impurities, (3) reactive gas treatment of molten silicon, and (4) slagging using a mixed-oxide slag. In this quarterly period purification by vacuum treatment and by impurity redistribution using ingot pulling has been studied. Procedures and results are reported.

34643 (PB—80-802218) **Cadmium sulfide solar cells. Volume 1. 1964-1977 (citations from the NTIS data base). Report for 1964-1977.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 256p. NTIS PCN01/MF N01.

Citations from Federally-funded research cover cadmium sulfide solar cell theory, design, development, fabrication, and degradation. Studies include junctions with thin films of copper sulfide, selenides, and tellurides. The performance, testing, analysis, efficiency, and costs of these cells are covered. (This updated bibliography contains 248 abstracts, none of which are new entries to the previous edition.)

34644 (SAN—1576-3) **Cadmium sulfide/copper sulfide heterojunction cell research. Final report, July 1, 1977-August 31, 1978.** Meakin, J.D. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). May 1979. Contract EG-77-C-03-1576. 131p. NTIS, PC A07/MF A01.

Thin film CdS/Cu_2S solar cells have been produced with energy conversion efficiencies up to 9.15% as measured in natural sunlight. The yield of cells has been maintained at a high level and out of a group of 65 cells that were completed with an anti-reflection coating over 92% had efficiencies above 7%, 72% exceeded 8% and 11% exceeded 9%. Cells based on the modified heterojunction (CdZn)S/Cu_2S are also under development and have now reached efficiencies of 7.4%. A technique has been developed to produce homogeneous films of (CdZn)S with controlled composition and low resistivities suitable for high efficiency solar cells. Both cell development programs continue to be driven by the loss minimization methodology. In addition to providing direction and feedback to the cell production efforts, the accompanying analysis has established that the limit on achievable cell efficiency is in the range of 11 to 12% for CdS/Cu_2S and 14 to 16% for (CdZn)S/Cu_2S. The model of cell structure and operation has been refined and further quantified. A technique has been developed to give a direct measure of the carrier losses at the junction. The functional dependence of the interface recombination rate, junction field and collected current has been derived and experimentally confirmed. The importance of hole traps in the CdS has been shown and some progress made in relating the trap population to the CdS growth conditions. Further demonstration of reversibility of Cu_2S oxidation has been made and related to the long-term stability of CdS/Cu_2S cells. The necessary cell design changes to further improve the CdS/Cu_2S cell efficiency have been identified and a program planned for its achievement.

34645 (SAN—1876-1) **Thin-film polycrystalline silicon solar cells. Quarterly report No. 1, September 11-December 10, 1978.** Faughnan, B.W. (RCA Labs., Princeton, NJ (USA)). Jan 1979. Contract ET-78-C-03-1876. 25p. NTIS, PC A02/MF A01.

A total of 16 solar cells was fabricated in the first quarter. Half of these had diffused junctions and half had ion-implanted junctions. In each group of eight, six were made on Wacker Silso polycrystalline substrates and two on control single-crystal wafers. The solar-cell parameters were measured for all cells. The efficiencies of the control wafers were as high as 12.7% with antireflection (AR) coating, whereas the highest efficiency of a cell made on Wacker material was 11.1% for a diffused-junction cell. The ion-implanted cells made with the Wacker material had systematically lower efficiencies, 5.9% versus 7.4% for diffused-junction cells without AR coating. Quantum efficiency versus wavelength was measured on all cells, and these curves were fit to a simple model solar cell. From this fit the minority carrier diffusion length in the base was obtained. A laser scanning apparatus was built which has a 4.5-μm spot size. The solar cell under test is mechanically scanned across this focused laser spot. Laser scans were obtained over a 5 x 6-mm area on two solar cells. Comparison of the laser scan map with a photograph of the same region shows the same geometrical pattern of grain boundary lines. However, in the laser scan map, some of the grain boundaries are missing.

34646 (SAND—80-7103) **Automated linear concentrator cell module assembly.** Khemthong, S.; Ling, K.S.; Olah, S.; Sampson, W.J. (Applied Solar Energy Corp., City of Industry, CA (USA)). Aug 1980. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01.

The objectives of this program were to reduce the cost of linear photovoltaic concentrator cell modules by reducing the cost of interconnection, encapsulation, and module assembly; to design and fabricate equipment for semi-automation; and to fabricate and deliver five (5) prototype modules of approximately four (4) feet in length utilizing semi-automated equipment. All of these objectives have been accomplished. The procedure and equipment are described.

34647 (SAND—80-7104) **Interdigitated back contact solar cells. Annual report.** Lundstrom, M.S.; Schwartz, R.J. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). Aug 1980. Contract AC04-76DP00789. 144p. NTIS, PC A07/MF A01.

The interdigitated back-contact solar cell (IBC cell) has been shown to possess a number of advantages for silicon solar cells, which operate at high concentration. The purpose of the present program is to support the Sandia Laboratory effort to optimize the IBC cell. A detailed discussion of the factors which need to be considered in the analysis of semiconducting devices which utilize heavily doped regions such as those which are found in solar cells in both the emitter and in the back surface field regions is given. This discussion covers the questions of: how to handle degeneracy, how to compute carrier concentrations in the absence of knowledge of the details of the band structure under heavily doped conditions, how to reconcile the usual interpretation of heavy doping as a rigid shift of the bands with the band tailing and impurity level conduction models. It also discusses the reasons for the observed discrepancy between various experimental measurements of bandgap narrowing. A discussion of the appropriateness of using experimentally determined parameters in conjunction with degenerate statistics in calculating cell performance is also presented. A detailed discussion of the one dimensional formulation of the solar cell analysis as well as a description of the one dimensional programs which have been writtten to perform this analysis are included. The results of calculations using the one dimensional program to analyze typical situations which occur in high intensity conventionally designed silicon solar cells are presented.

34648 (SERI/PR—8012-1-T1) **Thin film cadmium sulfide/mixed copper ternary heterojunction solar cells. Third quarterly technical progress report, August 13-November 12, 1979.** Loferski, J.J. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jun 1980. Contract AC02-77CH00178. 48p. NTIS, PC A03/MF A01.

The properties of pentenary films produced by rf-sputtering from a target prepared from a powder having the composition $CuIn_{0.3}Ga_{0.7}Se_{1.2}Te_{0.8}$ do not exactly replicate the properties of the target material. Selected experimental conditions result in films whose

summary compositions are approximately CuIn/sub y/Ga/sub 1-y/Se/sub 2z/Te/sub 2(1-z)/, but the value of y not identical with 0.3 and of z not identical with 0.6. In general, z is substantially less than 0.6, (i.e. the films are selenium deficient) while y is only a little less than 0.3. Annealing the as-sputtered films in stoichiometric powder improves the film properties. A calculation of the limit efficiency of direct gap semiconductor p/n homojunction solar cells incorporating minority carrier mirrors and optical mirrors shows that thin (1 to 2 μm thick) cells can achieve higher efficiencies than thicker cells and that for $CuInSe_2$, this upper limit efficiency is about 26%. The calculations are applicable to heterojunction devices like those we are trying to fabricate, especially if there are no interface states to control the reverse saturation current. A photovoltaic effect has been observed in a device made from a $CuInSe_2$ thin film produced by chemical spray pyrolysis. Photovoltaic cells having AM1 efficiencies up to 13% have been fabricated from large grained samples of pentenary alloys.

34649 (SERI/PR—8170-1-T1) **Indium phosphide/cadmium sulfide thin-film solar cells. Quarterly technical progress report No. 3, December 1979-April 1980.** Zanio, K. (Hughes Research Labs., Malibu, CA (USA)). Jun 1980. Contract AC02-77CH00178. 23p. NTIS, PC A02/MF A01.

Thin films (~ 1 μm thick) and large grains (~ 40 x 40 μm) of InP were epitaxially deposited on low-cost recrystallized CdS (RXCdS) substrates at 280°C by planar reactive deposition. At 380°C, a 0.4- to 1.0-μm-thick In-Cd-S transition layer between the InP and the RXCdS degrades the quality of the InP epitaxy. However, p-type InP films were prepared at this temperature by Be-doping and capping the entire RXCdS substrate with InP. Large grains of CdTe (~ 40 μm) were also deposited on RXCdS substrates at 460°C by physical vapor deposition. The grain size of the RXCdS is typically 40 μm. However, during this period we prepared RXCdS with grains having dimensions up to 300 μm.

34650 (SERI/TR—8010-1-T1) **Cadmium sulfide/copper ternary heterojunction cell research. Final report, January 8, 1979-June 7, 1980.** Fleming, D.L. (Sperry Univac, St. Paul, MN (USA)). 1980. Contract AC02-77CH00178. 29p. NTIS, PC A03/MF A01.

Dual source, Se and $CuInSe_2$, coevaporation and flash evaporation of stoichiometric $CuInSe_2$ powder were investigated to develop a process of fabricating large area $CdS/CuInSe_2$ heterojunction solar cells. $CuInSe_2$ was seen to decompose upon evaporation, producing layered films in the dual source system. Annealing of these films and alternative dual sources have been considered. Single phase p type films have been produced but no devices have been made from such films. Flash evaporation circumvents the decomposition problem, and if one bakes the powder to obtain a small Cu excess as well as getting a Se excess in the film, p type $CuInSe_2$ films can be obtained. A 1% efficient device of 6 cm^2 area was made using a flash evaporated $CuInSe_2$ film. Annealing studies and measurements of spatial uniformity of this device are reported.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 34622, 34623, 35475, 35526

34651 (CONF-790789—1) **Research, development, and commercialization activities on biomass energy in the United States.** Klass, D.L. (Institute of Gas Technology, Chicago, IL (USA)). 1979. 13p. NTIS, PC A02/MF A01.

From UK section International Solar Energy Society meeting; London, UK (3 Jul 1979).

Research and development activities in the US on the production of energy products and synthetic fuels from organic wastes and land- and water-based biomass are growing rapidly. Commercialization of the results of this effort is also progressing but at a lower rate. Commercial plants are currently operating to produce steam and electric power by combustion or co-combustion of municipal solid wastes, agricultural residues, and wood; methane from landfills and cattle manure; and fermentation alcohol for use in gasohol blends. Available fossil fuels are still sufficiently low in cost in the US to make the economics of producing substitute fuels from biomass borderline or unattractive. Large-scale integrated biomass energy systems are therefore not expected to be constructed and operated until the late 1980's and early 1990's. Nevertheless, about 2.1% of the US total energy supply is now derived from biomass; this corresponds to about 1.7 x 10^{15} Btu.

34652 (CONF-791108—26) **Effect of structure on hydrolysis of cellulose.** Chang, M.; Tsao, G.T. (Purdue Univ., Lafayette, IN (USA). Lab. of Renewable Resources Engineering). 1979. Contract AS02-76ER02755. 39p. NTIS, PC A03/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The acid and the enzymatic hydrolyses of cellulose are discussed with respect to the crystallite structures of the polymer. For acid hydrolysis, the catalytic hydrogen ions can penetrate the amorphous areas of cellulose so that the initial chain scissions take place preferentially in these areas to give a rapid drop in chain length and then level-off at the crystallite level. Further degradation proceeds randomly on the surfaces of the crystallite and an initial weight loss can be attributed to the dissolution of oligomers into the reaction medium. The bulky size of the enzyme hinders the substrate penetration. The mode of degradation can be very different from the acid. For native cellulose whose crystalline order is generally high, a limited C/sub x/ activity had been observed. The rapid drop in chain length was observed only for the swollen cellulose. The crystallite structure in the latter may be opened up by the swelling pretreatment. Interpretations based on both the fringe-micellar model and the folding chain model are given to these experimental observations. In all cases, the folding chain model appears to be a competent model.

34653 (CONF-791216—4) **Marine macroscopic plants as biomass sources.** North, W.J. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). 1979. Contract AC03-76ET20000. 25p. NTIS, PC A02/MF A01.

From Conference on long-term energy resources; Montreal, Canada (3 Dec 1979).

Characteristics of marine plants, recent and current research, and studies at Woods Hole Oceanographic Institution and California Institute of Technology are reviewed. The latter program including laboratory and field studies on giant kelp is discussed. The use of deep ocean water and the nutrient requirements of giant kelp were studied. Test farm structure and problems are presented. (MHR)

34654 (CONF-800482—5) **Sorghums as energy crops.** Lipinsky, E.S.; Kresovich, S. (Battelle Columbus Labs., OH (USA)). 1980. Contract W-7405-ENG-92-077. 18p. NTIS, PC A02/MF A01.

From Bio-energy world congress and exposition; Atlanta, GA, USA (21 Apr 1980).

The botanical, physiological, and agronomic characteristics of sorghum are described. Integration concepts to improve sorghum prospects are discussed as follows: multiple sweet sorghum crops each year, integration with sugarcane, integration with sugar beets, integration with starch crops, sweet stemmed grain sorghum, and integration with lignocellulosic crops. (MHR)

34655 (CONF-800482—6) **Kelp growth experiments.** North, W.J. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). 1980. Contract AC03-76ET20000. 12p. NTIS, PC A02/MF A01.

From Bio-energy world congress and exposition; Atlanta, GA, USA (21 Apr 1980).

Harvest yields obtainable from giant kelp plants that are adequately fertilized were investigated. The following topics are discussed: desirable characteristics in a candidate macroalga, and giant kelp as a candidate macroalga for ocean farming. Nutrient requirements, field experiments, and approaches to acquiring yield data are reviewed. (MHR)

34656 (CONF-7903137—1) **Production of high value solid fuels from cellulosic feed materials by the Koppelman process.** Murray, R.G. (SRI International, Menlo Park, CA (USA)). 1979. Contract AT03-76ET20064. 18p. NTIS, PC A02/MF A01.

From International gas turbine conference; San Diego, CA, USA (12 Mar 1979).

When wet cellulosic material is heated to 500°C in an autoclave at 100 atmospheric pressure, the resulting solid product is dry and has a heating value ranging from 6700 to 7800 cal/g (12,000 to 14,000 Btu/lb). This treatment is the basis for the Koppelman Process covered in US Patent 4,052,168. Test results and product characteristics are described.

34657 (COO—2948-3) **Cultivation of macroscopic marine algae and freshwater aquatic weeds. Progress report, May 1-December 31, 1978.** Ryther, J.H. (Woods Hole Oceanographic Institution, MA (USA)). Jan 1979. Contract AS02-76EV02948. 126p. NTIS, PC A07/MF A01.

Studies were continued during 1977 to 1978 on the growth and yields in culture of the red seaweed Gracilaria tikvahiae. Partial control of epiphytes was achieved by nutrient removal, shading, and/or biological agents. For the first time, a single clone of the alga was grown continuously throughout the year without replacement. Yields in large (2600 l) aluminum tanks averaged 21.4 g dry weight/m^2.day, equivalent to 31 tons/acre.year (15.5 ash-free dry wt tons/acre.year). Growth of Gracilaria and other seaweeds in Vexar-mesh baskets in natural habitats and in the oceanic waters of a power plant cooling water intake canal were unsuccessful. Productivity of the freshwater macrophytes Lemna minor (common duckweed), Eichhornia crassipes (water hyacinth), and Hydrilla verticillata have now been measured throughout the year with mean yields of 3.7, 24.2 and 4.2 g dry weight/m^2.day (5.4, 35.3, and 6.1 dry tons/acre.year) respectively. Yields of duckweed and water hyacinths in the Harbor Branch Foundation culture units have averaged roughly three times those of the same species growing in highly-eutrophic natural envi-

ronments. The yields of several other species of freshwater plants were investigated. Only the pennywort (Hydrocotyle umbellata) appears to approach the productivity of water hyacinth on the basis of preliminary measurements. Chopped water hyacinths and unprocessed Gracilaria have both been successfully fermented to methane in anaerobic digesters and the liquid digester residues recycled to produce more of the same plants.

34658 (COO—4147-7) **Bioconversion of plant biomass to ethanol. Final report, 15 December 1976-31 December 1978.** Brooks, R.E.; Su, T.M.; Brennan, M.J. Jr.; Frick, J.; Lynch, M. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). Jul 1979. Contract AC02-77ET20016. 50p. NTIS, PC A03/MF A01.

Two approaches to ethanol production via thermophilic mixed culture fermentation of pretreated wood were investigated. The initial studies of wood biodelignification by Chrysosporium pruinosum and subsequent mixed culture fermentation to ethanol using a cellulolytic strain of sporocytophaga and a strain of Bacillus stearothermophilus proved to be premature for a development effort. Studies of the fermentation of SO_2/steam-treated poplar by a mixed culture of C. thermocellum and C. thermosaccharolyticum were, however, technically and economically promising. Wood pretreatment to enhance microbial utilization, the microbiology and biochemistry of pure and mixed culture fermentation of cellulose by C. thermocellum and C. thermocellum and C. thermosaccharolyticum, and techniques for improving ethanol tolerance and yield were investigated. Considerable progress in overcoming the technical barriers to efficient ethanol production from wood have been demonstrated; however, additional studies and development work are required before technical feasibility can be established.

34659 (DOE/ET/20006—T1) **Increasing the biomass production of short rotation coppice forests. Progress report.** Steinbeck, K.; Brown, C.L. (Georgia Univ., Athens (USA). School of Forest Resources). Sep 1980. Contract AS09-77ET20006. 32p. NTIS, PC A03/MF A01.

The objective of the project is to increase biomass yields from coppice forests by admixing tree species (Alnus glutinosa, Robinia pseudoacacia and others) to plantations of Platanus occidentalis and Liquidambar styraciflua. Yield increases due to intensive cultivation, especially fertilization and irrigation, will be documented. A genetic improvement program of promising candidate species both through the identification of superior genotypes and mass cloning with tissue culture is also included. Three plantings have been established successfully to screen candidate species on various sites and to test the effects of weed control, fertilization and irrigation on short rotation forests. Two plantations in Georgia are in their 2nd and 3rd growing seasons while one in South Carolina is in its 1st growing season. A two acre plantation has been established to test development of geographic seed source material for sycamore. A nursery is in operation to develop seedling production methods for new species and to grow and maintain genetic material. Mass cloning of selected material by tissue culture techniques has produced material for testing in outplantings.

34660 (DOE/ET/20074—T1) **Eucalyptus plantations for energy production in Hawaii. Technical status report, October 1, 1978-June 30, 1980.** (BioEnergy Development Corp., Hilo, HI (USA)). 14 Jul 1980. Contract FC03-78ET20074. 17p. NTIS, PC A02/MF A01.

Progress made on accomplishing research objectives is reported. The objectives of this project are: (1) to increase the biomass production of Eucalyptus; (2) to determine the optimum requirements to maximize yield; (3) to assess planting, cultivation, harvesting, and transportation equipment requirements; (4) to determine the optimum mixture of biomass (eucalyptus and bagasse) at the generator for the production of electricity; and (5) to evaluate a complete production/conversion system which utilized optimum management conditions in relationship to costs. (DMC)

34661 (DOE/ET/20606—1) **Energy biomass tree seedling production study. Progress report, January 1980-May 1980.** Foote, K.R. (General Electric Co., Syracuse, NY (USA). Controlled Environment Agriculture Operation). Jun 1980. Contract AC02-78ET20606. 23p. NTIS, PC A02/MF A01.

Two lamp evaluation studies were conducted in the Geniponics system to determine the effect, if any, of various light treatments on tree seedling growth. A sixteen hour photoperiod followed by an uninterrupted eight hour dark period was utilized for this test series. Temperatures during the light period were held at 27°C +- 1°C. Carbon dioxide levels were maintained at 1500 parts per million during the light period. The tree seedlings were sub-irrigated with a high phosphate nutrient solution. Data was collected from twenty-five randomly selected seedlings from each of the replicated containers from each treatment. Heights were recorded to the nearest tenth of a centimeter. Root collar diameters, taken at media-atmosphere interface, were recorded to the nearest one-hundredth of a millimeter as measured with a Helios metric vernier caliper. Dry weights were recorded to the nearest ten-thousandth of a gram on a Sartorius 2003 MPI analytical recording balance. Light measurements were made with a Lambda Instruments LI-170 meter with quantum sensor.

34662 (DOE/ET/23050—1) **Optimization of steam explosion pretreatment. Final report.** Foody, P. (Iotech Corp., Ottawa, Ontario (Canada)). Apr 1980. Contract AC02-79ET23050. 383p. TIC.

Different operating conditions are required to optimize the yield from each of the various fractions in the substrate. Xylose recovery is maximized at short cooking times whereas maximum lignin recovery requires much longer cooking times. Peak glucose yield and rumen digestibility occur at intermediate times. If process conditions are set for maximum glucose yield we have achieved a yield of 68% of the theoretical, based on an average of a dozen substrates tested. Individual results ranged from 46 to 87%. If the process is optimized for maximum total sugars (i.e. glucose plus xylose) we have obtained an average yield of 60%, with a range of 31 to 75%. With rumen microflora, the average value of the in-vitro cellulose digestibility was 82%, with a range of 41 to 90%. The optimum operating conditions for total sugars are a pressure of 500 to 550 psig with a cooking time of 40 to 50 seconds and 35% starting moisture content. Particle size is not a significant factor, nor is presteaming or use of a constricting die in the gun nozzle. High quality lignin can be extracted with 80% yield. The Iotech lignin is very soluble, has a low molecular weight and is reactive. The unique properties of the lignin derive from the explosion at the end of the pretreatment. A lignin formaldehyde resin has been successfully formulated and tested. It represents a high value utilization of the lignin byproduct with immediate market potential. A detailed engineering design of the process gives an estimated operating cost of $7.50/OD ton of biomass. At this low cost, the Iotech process achieves many important pretreatment goals in a single step. The substrate has been sterilized; it has been pulverized into a powder; the cellulose has been accessible; and a highly reactive lignin fraction can be recovered and utilized.

34663 (DOE/TIC—11252) **Fuels and chemicals from woody biomass program. Program plan FY82-86.** (Oak Ridge National Lab., TN (USA)). 7 Feb 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

The feasibility of producing and procuring woody biomass for purposes of near-term energy production and petrochemical substitution is demonstrated. The harvesting and handling of the biomass and the kind of procurement system needed to assure adequate supplies are discussed. Economics and energetics of producing woody products for conversion purposes or other uses for wood are considered. Regional and national assessments of wood technology environmental impacts and land use are also provided. The legal aspects involved in the commercialization of wood energy are also considered. (DMC)

34664 (DOE/TIC—11253) **Fuels and chemicals from woody biomass program: management plan.** (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 58p. NTIS, PC A04/MF A01.

The objectives of this program are to develop, manage, and administer the Fuels and Chemicals from Woody Biomass Program (FCWB) for the Biomass Energy Systems Branch (BES) of the Division of Distributed Solar Technology. Activities include both technical and fiscal management. The goals of this program are to expeditiously and efficiently improve the productivity and economic availability of wood for energy through basic and applied research, and to maximize opportunities for commercialization of wood energy or petrochemical substitution in a timely manner.

34665 (ISU-ERI-AMES—80062) **Conversion of agricultural by-products to sugars. Progress report.** Reilly, P.J. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Oct 1979. 67p. Iowa State Univ., Ames.

Much work has been directed toward producing glucose from cellulose, while less effort has been forthcoming on investigating the breakdown of hemicellulose and lignin, the other two major components of the cellulosic complex. Hardwoods and grasses have hemicelluloses high in xylon, a heterogeneous branched polysaccharide composed largely of xylose. This report presents research on the purification, physical characterization, and determination of specificity of several xylanases. Molecular weight, amino acid concentration, absorbance, temperature dependence, and pH effect on activity are presented for fraction C xylanases of high and low isoelectric points and fraction B xylanases of high isoelectric point. Separation techniques are described. (DMC)

34666 (SERI/TR—332-586) **Research into the pyrolysis of pure cellulose, lignin, and birch wood flour in the China Lake entrained-flow reactor.** Diebold, J. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1980. Contract AC02-76CH00178. 41p. NTIS, PC A03/MF A01.

This experimental program used the China Lake entrained-flow pyrolysis reactor to briefly investigate the pyrolysis of pure

cellulose, pure lignin, and birch wood flour. The study determined that the cellulose and wood flour do pyrolyze to produce primarily gaseous products containing significant amounts of ethylene and other useful hydrocarbons. During attempts to pyrolyze powdered lignin, the material melted and bubbled to block the reactor entrance. The pure cellulose and wood flour produced C_2 + yields of 12% to 14% by weight, which were less than yields from an organic feedstock derived from processed municipal trash. The char yields were 0.1% by weight from cellulose and 1.5% from birch wood flour - one to two orders of magnitude less than were produced from the trash-derived feedstock. In scanning electron microscope photographs, most of the wood flour char had a sintered and agglomerated appearance, although some particles retained the gross cell characteristics of the wood flour. The appearance of the char particles indicated that the material had once been molten and possibly vapor before it formed spheroidal particles about 1 μm diameter which agglomerated to form larger char particles. The ability to completely melt or vaporize lignocellulosic materials under conditions of high heating rates has now been demonstrated in a continuous flow reactor and promises new techniques for fast pyrolysis. This char was unexpectedly attracted by a magnet, presumably because of iron contamination from the pyrolysis reactor tube wall. The production of water-insoluble tars was negligible compared to the tars produced from trash-derived feedstock. The production of water-soluble organic materials was fairly low and qualitatively appeared to vary inversely with temperature. This study was of a preliminary nature and additional studies are necessary to optimize ethylene production from these feedstocks.

34667 University of Kansas energy forest. Final report to the Ozarks Regional Commission. Naughton, G.G. Manhattan, KS; Kansas State University (1980). 77p. (NP—25095).

The results of a four year study into the feasibility of using wood fuels to carry the peak load requirements of a proposed new central steam facility at the University of Kansas campus in Lawrence are summarized. The presumed primary fuel for this new plant is municipal solid waste. It is concluded that the addition of a separate wood fired furnace is technically and economically feasible. The following topics are covered: burning wood as a supplement to solid waste; available wood supply; growth, yield, and management implications on firewood plantations for eastern Kansas; insect and disease management in energy forest plantations; cost analysis - energy forest plantations; chipping wood; transportation of wood; and environmental impacts. (MHR)

34668 Hydrogen production by marine photosynthetic bacteria: environmental factors and substrate specificity of the growth of a hydrogen producing marine photosynthetic bacterium, Chromatium sp. Miami PBS 1071. Ohta, Y.; Frank, J.; Mitsui, A. Miami, FL; Pergamon Press, Ltd. (1980). 14p. (CONF-800616—9).

From 3. world hydrogen energy conference; Tokyo, Japan (23 Jun 1980).

The growth potential of the marine Chromatium sp. Miami PBS 1071, a strain of photosynthetic bacteria exhibiting high hydrogen production capabilities, was studied. This strain isolated by our laboratory from the subtropical marine environment grows well at high light intensities (light saturation: 140 μ Einsteins/m^2/sec), high temperature (optimum: 34°C), salinities normally found in marine environments (optimum: 30‰) and slightly basic pH's (optimum: 7.4 to 8.1). This strain grows in sulfide concentrations of 0.5 to 2.5 mM, and oxygen less than 4%. The growth rate in terms of doubling time was 1.75 hours, which is one of the fastest rates observed for marine photosynthetic bacteria. Thus, the strain would be well suited for application to a saltwater based tropical or subtropical outdoor mass culturing system linked to bio-solar hydrogen production technologies. This strain cannot utilize carbohydrates for growth but can employ various other carbon and nitrogenous compounds. Besides the subject of utilization, the contribution of this work to the study of primary productivity and ecology in tropical and subtropical marine environments is discussed.

34669 Photosynthetic bacteria as alternative energy sources: overview on hydrogen production research. Mitsui, A.; Ohta, Y.; Frank, J. Miami, FL; Hemisphere Publishing Corp. (1979). 32p. (CONF-791204—40).

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Hydrogen production research towards the application of marine and non-marine species of photosynthetic bacteria is reviewed. Potential use of photosynthetic bacteria as renewable energy resources is discussed.

34670 Small-scale space heating with wood-waste, brush, and logging residue fuels. Riley, J.G.; Smyth, D.A.; Smith, N. St. Joseph, MI; American Society of Agricultural Engineers (1979). 16p. (CONF-791253—3).

From Winter meeting of American Society of Agricultural Engineers; New Orleans, LA, USA (11 Dec 1979).

Equipment has been developed for utilizing chipped wood fuels in automatic space-heating systems for residential and institutional applications. Design, construction and testing of prototypes are described, together with information on practical problems of installation and operation of pre-commercial units now in use.

34671 Machine to harvest and chip brush stands. Monico, J.A.; Soule, H.M. St. Joseph, MI; American Society of Agricultural Engineers (1979). 15p. (CONF-791253—2).

From Winter meeting of American Society of Agricultural Engineers; New Orleans, LA, USA (11 Dec 1979).

A machine based on the operating principle of simultaneous felling and chipping has been developed to produce fuel wood chips from puckerbrush stands. Design, construction and preliminary test results are described along with future work and chip requirements for optimum burning.

34672 Storage and feeding of woodchips for fuel. Smyth, D.A.; Riley, J.F. St. Joseph, MI; American Society of Agricultural Engineers (1979). 25p. (CONF-791253—1).

From Winter meeting of American Society of Agricultural Engineers; New Orleans, LA, USA (11 Dec 1979).

Design procedures have been developed, using dimensional analysis and experimental testing, for woodchip fuel storage and feed systems. A description is given of the use of these systems in conjunction with small-scale automatic furnaces for space heating, and field experiences with several pre-commercial prototypes are related.

34673 Wet bark processing for use as fuel. Smyth, D.A. St. Joseph, MI; American Society of Agricultural Engineers (1978). 16p. (CONF-7808126—1).

From Annual meeting North Atlantic region of the American Society of Agricultural Engineers; Amherst, MA, USA (6 Aug 1978).

A processing system to lower the moisture content of wet waste bark from 65 to 70% (wet basis) to 40% by mechanical dewatering (expression) followed by thermal drying is described. A small (1 cfh) continuous feed bark expression machine was built which lowers the moisture content of the bark to 55% at which point a rotary drier further dries the bark.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

34674 (LBL—11232) Vectorially photoinduced electron-transfer processes across water-in-oil interfaces of microemulsions. Willner, I.; Otvos, J.W.; Calvin, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 33p. (CONF-8006111—1). NTIS, PC A03/MF A01.

From 10. North Eastern regional meeting of the American Chemical Society; Potsdam, NY, USA (29 Jun 1980).

Artificial photosynthetic devices are potential fuel sources. The basic idea in the design of such devices is a photosensitized electron-transfer that yields chemical species capable of reducing and oxidizing water to hydrogen and oxygen. A fundamental difficulty in effecting this transfer is the thermodynamically favored back reactions of the intermediary redox species. An interfacial model composed of a water-in-oil microemulsion is suggested to provide the separation of these redox species, thereby preventing back-reactions. This model is designed to accomplish the photodecomposition of water in two separate water-in-oil microemulsions coupled by a redox reaction. Phase-transfer of one of the redox products from the water-in-oil interface to the continuous organic phase is the principle by which separation is achieved. The oxidation and reduction sites of the general model have been constructed. One system includes the photosensitized oxidation of a donor, EDTA, solubilized in the water pool, benzylnicotinamide acts as a primary acceptor that mediates by the phase transfer principle the reduction of a secondary acceptor, dimethylamino-azobenzene, solubilized in the continuous organic phase. In system two, involving the photosensitized reduction of methyl viologen, by tris(2,2'bipyridine)Ru(2+), thioophenol is used as the donor and its oxidation product is phase transferred to the continuous organic phase. The photoinduced processes accomplished in the two systems proceed along an uphill gradient of free energy. Two water soluble zinc-porphyrins can substitute for the Ru(2+) complex in the second system. As the two Zn-porphyrins are oppositely charged, the effect of electrostatic interactions on the quantum yields of viologen reduction could be evaluated. The results suggest that the surface charge of the wateroil interface strongly influences the efficiency of electron-transfer.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 34631, 34643, 34678, 34679, 34680, 34742, 34888

34675 (DOE/JPL/955367—80/1) **Photovoltaic module electrical termination design requirement study. Final report.** Mosna, F.J. Jr.; Donlinger, J. (Motorola, Inc., Phoenix, AZ (USA); ITT Cannon, Santa Ana, CA (USA)). Jul 1980. Contract NAS-7-100-955367. 150p. NTIS, PC A07/MF A01.

Motorola Inc., in conjunction with ITT Cannon, has conducted a study to develop information to facilitate the selection of existing, commercial, electrical termination hardware for photovoltaic modules and arrays. Details of the study are presented in this volume. Module and array design parameters were investigated and recommendations were developed for use in surveying, evaluating, and comparing electrical termination hardware. Electrical termination selection criteria factors were developed and applied to nine generic termination types in each of the four application sectors. Remote, residential, intermediate and industrial. Existing terminations best suited for photovoltaic modules and arrays were identified. Cost information was developed to identify cost drivers and/or requirements which might lead to cost reductions. The general conclusion is that there is no single generic termination that is best suited for photovoltaic application, but that the appropriate termination is strongly dependent upon the module construction and its support structure as well as the specific application sector.

34676 (DOE/JPL/955614—80/1) **Operation and maintenance cost data for residential photovoltaic modules/panels.** (Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA)). Jul 1980. Contract NAS-7-100-955614. 107p. NTIS, PC A06/MF A01.

Burt Hill Kosar Rittelmann Associates has conducted a study to identify and estimate costs associated with the operation and maintenance of residential photovoltaic modules and arrays. Six basic topics related to operation and maintenance to photovoltaic arrays were investigated - General (Normal) Maintenance, Cleaning, Panel Replacement, Gasket Repair/Replacement, Wiring Repair/Replacement, and Termination Repair/Replacement. The effects of the mounting types - Rack Mount, Stand-Off Mount, Direct Mount, and Integral Mount - and the installation/replacement type - Sequential, Partial Interruption, and Independent - have been identified and described. Recommendation on methods of reducing maintenance costs are made.

34677 (DOE/NASA/0049—80/1) **Market definition study of photovoltaic power for remote villages in the United States.** Ragsdale, C. (Motorola, Inc., Phoenix, AZ (USA)). Feb 1980. Contract AI01-76ET20485. 76p. (NASA-CR—159800). NTIS, PC A05/MF A01.

A grass roots evaluation of the market potential for photovoltaic applications in remote villages in the US and its territories provides an estimate of almost 14 MWp available for conversion from a potential to a real market. This total power potential is based on the energy needs of almost 400 sites reported by federal agencies and inputs from over 100 Indian tribes. This potential consists of the following: US government agencies-3000 KWp; Indian villages-10,000 KWp; Alaskan villages-370 KWp; territories-500 KWp; and US commercial-negligible. The report details the methodology used, the results achieved, and some recommendations of how to convert this domestic market potential into a real market and its contribution to preparing for the really large village power market potential that exists in developing countries.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 34631, 34761, 34888

34678 (PB—80-802531) **Solar water pumps (citations from the Engineering Index data base). Report for 1970-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 72p. NTIS PCN01/MF N01.

Design concepts and the technical and economic feasibility of using solar energy to pump water are discussed in abstracts from worldwide literature. Topic areas cover the use of solar heat actuated Rankine cycle engines and free cylinder Stirling engines for solar powered water pumps, pumps driven by photovoltaic modules, and application of solar pumps to irrigation and electric power generation. (This updated bibliography contains 65 abstracts, 25 of which are new entries to the previous edition.)

34679 (PB—80-803018) **Solar electric power generation. Volume 3. October 1978-November 1979 (citations from the NTIS data base). Report for October 1978-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 141p. NTIS PCN01/MF N01.

Citations of Federally-funded research are presented pertaining to electric power generation by both direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover equipment design, site surveys, economics, and feasibility studies of solar power satellite systems, photovoltaic systems, solar total energy systems, and central receiver solar thermal power systems. A few abstracts deal with phase change materials and thermal energy storage systems. Abstracts dealing with solar sea power generation and basic research on heliostat systems are covered in other Published Searches; spacecraft power supply studies are excluded. (This updated bibliography contains 134 abstracts, all of which are new entries to the previous edition.)

34680 (PB—80-803034) **Solar electric power generation. Volume 3. October 1978-November 1979 (citations from the Engineering Index data base). Report for October 1978-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 115p. NTIS PCN01/MF N01.

A worldwide literature survey cites power generation by direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover solar tower power plants, orbital solar energy technology, photovoltaic power generation, and solar augmentation of hydroelectric power systems. A few abstracts pertain to the future role that solar energy will play in production of electric power and general studies comparing the technical and economic feasibility of various methods of electric power generation. Abstracts dealing with solar sea power generation and spacecraft power supplies are excluded. (This updated bibliography contains 108 abstracts, all of which are new entries to the previous edition.)

34681 (SERI/SP—733-526) **US Department of Energy Solar Thermal Energy Systems Program. An overview presentation, August 1979.** Braun, G.W. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1980. Contract AC02-77CH00178. 38p. (CONF-7908122—1). NTIS, PC A03/MF A01.

From Solar Energy Industries Association meeting; San Jose, CA, USA (9 Aug 1979).

Intended as both a position paper and a progress report to industry, this document provides a comprehensive overview of the US Department of Energy's Solar Thermal Program. Cost goals, systems design parameters, applications considerations, and the potential for industry involvement in solar thermal development and commercialization are described in detail. Decentralized management of R & D functions is linked to priorities and strategies of the evolving program.

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 34693, 34694, 34695, 34696

34682 (SAND—80-8020) **Five-tube test report.** Liebenberg, J. (Sandia National Labs., Livermore, CA (USA)). Aug 1980. Contract AC04-76DP00789. 104p. NTIS, PC A06/MF A01.

Sandia National Laboratories conducted an experiment investigating the Departure from Nucleate Boiling/Hydraulic Instability in support of the 10-megawatt central receiver solar pilot plant project in Barstow, California. The experiment provided fundamental fluid dynamics data that will improve the understanding of boiling in a one-side-heated single pass to superheat solar boiler panel. The purpose of this report is to document the test results and the experimental configuration. The data from 167 test runs, each with 250 data channels, have been condensed in summary plots and tables. The description of the apparatus, and the summarized data provide a clear characterization of the flow boiling phenomena unique to the five-tube experiment and the Barstow receiver. Although there are differences between the five-tube test hardware and the actual Barstow receiver panels, the differences are alluded to in this report, but not analyzed. That analysis will be the subject of other reports.

DISTRIBUTED COLLECTOR

34683 (SAND—80-1568) **150 kW/sub e/ solar irrigation project test and evaluation plan.** Torkelson, L.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01.

The 150 kW/sub e/ Solar Irrigation Project at Coolidge, Arizona consists of a 23,000-ft^2 line focus collector subsystem, a 30,000-gallon thermal storage subsystem, and a 150 kW/sub e/ power generation unit. The plan for the facility's testing and evaluation, a description of the facility, and the objectives of the project are given. Detailed test plans and a schedule are included.

TOTAL ENERGY AND HYBRID SYSTEMS

34684 (DOE/SF/10506—1) **Conceptual design of the solar repowering system for West Texas Utilities Company Paint Creek Power Station Unit No. 4. Final report.** (West Texas Utilities Co., Abilene (USA); Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Boeing Engineering and Construction Co., Seattle, WA (USA). Energy and Environment Div.; Houston Univ., TX (USA); Sargent and Lundy, Chicago, IL (USA)). 15 Jul 1980. Contract AC03-79SF10506. 771p. NTIS, PC A99/MF A01.

A conceptual design of a sodium-cooled, solar, central-receiver repowering system for West Texas Utilities' Paint Creek Unit 4 was prepared. The existing Paint Creek Unit 4 is a natural-gas-fired, baseload unit with a dependable net power output of 110 MWe. It is a reheat unit, has a main steam temperature and pressure of 538°C (1000°F) and 12.41 MPa (1800 psig), respectively, has a reheat temperature of 538°C (1000°F), and was placed in operation in 1972. On this conceptual design study program, a large number of trade studies and optimizations were carried out, in order to derive the most cost-effective design that had the greatest potential for widespread application and commercialization. As a result of these studies, the optimum power level for the solar part of the plant was determined to be 60 MWe, and provisions were made to store enough solar energy, so that the solar part of the plant would produce, on March 21 (equinox), 60 MWe of electric power for a period of 4 h after sunset. The tower in this system is 154 m (505 ft) high to the midpoint of the receiver, and is surrounded by 7882 heliostats (mirrors), each of which is 6.7 m (22 ft) by 7.3 m (24 ft). The mirror field occupies 1.74 x 10^6 m^2 (430 acres), and extends 1040 m (3400 ft) to the north of the tower, 550 m (1800 ft) to the south of the tower, and is bounded on the east and west by Lake Stamford. The receiver, which is of the external type, is 15.4 m (50.5 ft) high by 14 m (45.9 ft) in diameter, and is capable of absorbing a maximum of 226 MW of thermal energy. The set of sodium-to-steam generators consists of an evaporator, a superheater, and a reheater, the power ratings of which are 83.2, 43.7, and 18.1 MWt, respectively. Conceptual design, system characteristics, economic analysis, and development plans are detailed. (WHK)

34685 (DOE/SF/10506—1(Exec.Summ.)) **Conceptual design of the solar repowering system for West Texas Utilities Company Paint Creek Power Station Unit No. 4.** (West Texas Utilities Co., Abilene (USA); Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Boeing Engineering and Construction Co., Seattle, WA (USA). Energy and Environment Div.; Houston Univ., TX (USA); Sargent and Lundy, Chicago, IL (USA)). 15 Jul 1980. Contract AC03-79SF10506. 53p. NTIS, PC A04/MF A01.

A conceptual design of a sodium-cooled, solar, central-receiver repowering system for West Texas Utilities' Paint Creek Unit 4 was prepared, solely under funds provided by West Texas Utilities (WTU), the Energy Systems Group (ESG) of Rockwell International, and four other support groups. A central-receiver repowering system is one in which a tower, surrounded by a large field of mirrors, is placed adjacent to an existing electric power plant. A receiver, located on top of the tower, absorbs solar energy reflected onto it by the mirrors and converts this solar energy to heat energy. The heat energy is transported by the liquid sodium to a set of sodium-to-steam steam generators. The steam generators produce steam at the same temperature and pressure as that produced by the fossil boiler in the existing plant. When solar energy is available, steam is produced by the solar part of the plant, thus displacing steam from the fossil boiler, and reducing the consumption of fossil fuel while maintaining the original plant output. A means for storing the solar energy is usually provided, so that some energy obtained from the solar source can be used to displace natural gas or oil fuels when the sun is not shining. This volume presents an executive summary of the conceptual design, performance, economics, development plans, and site owner's assessment. (WHK)

34686 (DOE/SF/10607—1/1) **Solar repowering system for Texas Electric Service Company Permian Basin Steam Electric Station Unit No. 5. Final report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Texas Electric Service Co., Fort Worth (USA)). 15 Jul 1980. Contract AC03-79SF10607. 40p. NTIS, PC A03/MF A01.

A summary of the conceptual design and economic assessment of a sodium-cooled, solar central receiver repowering system for Texas Electric Service Company's Permian Basin Steam Electric Plant Unit No. 5 is presented. (WHK)

34687 (DOE/SF/10607—1/2) **Solar repowering system for Texas Electric Service Company Permian Basin Steam Electric Station Unit No. 5. Final report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group; Texas Electric Service Co., Fort Worth (USA)). 15 Jul 1980. Contract AC03-79SF10607. 598p. NTIS, PC A25/MF A01.

Details of the conceptual design and economic assessment of a sodium-cooled, solar central receiver repowering system for Texas Electric Service Company's Permian Basin Steam Electric Plant Unit No. 5 are presented. Successful construction and operation of a repowered unit during 1985 is projected. Environmental of institutional problems associated with the construction and operation of the Permian Plant Unit No. 5 are minimal. The estimated construction cost of this project is $11.6 x 10^6 in January 1, 1980 dollars; and the utility company's estimate of its equivalent plant investment is $12.5 x 10^6 in January 1, 1980 dollars. As expected, the economic assessment of the specific concept for this site indicates that the cost of energy is greater than that resulting from the burning of natural gas alone in the existing plant (principally, as a result of the current cost of heliostats and the scheduled retirement date of Unit No. 5). Favorable economics for similar types of plants can be projected for the future. The annual fuel savings are equivalent to 236,900 barrels of oil, with a total dollar value of $21.5 x 10^6 and $93.6 x 10^6 for a 7-year life and a 25-year life, respectively. However, it has also been found, from separate studies, that favorable interpretations of the Fuel Use Act will be necessary for this economic viability to be reached. In particular, a program to reduce the cost of heliostats to $100/$m^2$ will be needed. (WHK)

34688 (DOE/SF/10609—1) **Sierra Pacific Utility repowering. Final technical report, September 24, 1979-June 23, 1980.** Easton, C.R.; Endicott, D.L. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA); Sierra Pacific Power Corp., Reno, NV (USA)). Jun 1980. Contract AC03-79SF10609. 551p. (MDC-G—8667). NTIS, PC A24/MF A01.

The Sierra Pacific Power Company (SPPCo.) participated with the McDonnell Douglas team to define a conceptual design for repowering their Ft. Churchill plant, Unit 1. This unit has a modern, 110 MWe reheat turbine. The boiler is fired by oil and natural gas. The unit is based loaded at 0.78 capacity factor. The Ft. Churchill site is located in high desert, 75 km (47 mi) southeast of Reno, Nevada. The estimated annual average insolation is 7.2 kWh/m^2/day. The repowered plant conceptual design was a molten salt receiver fluid and 6 hours storage capacity. A north field collector with 130° azimuth extent was found to be optimum. The partial cavity receiver combines both external and cavity absorber regions to provide a compact, highly efficient design. A two tank storage unit with external insulation buffers system operation and provides for extended operation. A four element, tube and shell heat exchanger produces steam for turbine operation. The estimated annual average energy collection efficiency is 0.618. The plant annual energy output is about 290 GWhe, displacing the equivalent of 490,000 bbl oil per year. Repowering was found to be close enough to breakeven, economicaly, to be very attractive. Legal and institutional barriers are minimal. As a result, a very aggressive repowering program including Ft. Churchill is recommended as a means for reducing dependence on foreign oil.

34689 (DOE/SF/10609—1(Exect.Summ.)) **Sierra Pacific Utility repowering. Final technical report, September 24, 1979-June 23, 1980.** Easton, C.R.; Endicott, D.L. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA); Sierra Pacific Power Corp., Reno, NV (USA)). Jun 1980. Contract AC03-79SF10609. 43p. (MDC-G—8667(Exect.Summ.)). NTIS, PC A03/MF A01.

The Sierra Pacific Power Company (SPPCo.) participated with the McDonnell Douglas team to define a conceptual design for repowering their Ft. Churchill plant, Unit 1. This unit has a modern, 110 MWe reheat turbine. The boiler is fired by oil and natural gas. The unit is based loaded at 0.78 capacity factor. The repowered plant conceptual design was a molten salt receiver fluid and 6 hours storage capacity. A north field collector with 130° azimuth extent was found to be optimum. The partial cavity receiver combines both external and cavity absorber regions to provide a compact, highly efficient design. A two tank storage unit with external insulation buffers system operation and provides for extended operation. A four element, tube and shell heat exchanger produces steam for turbine operation. An executive summary of the study is presented.

34690 (DOE/SF/10738—1/1) **Solar repowering for electric generation: Northeastern Station Unit 1, Public Service Company of Oklahoma. Executive summary.** (Black and Veatch Consulting Engineers, Kansas City, MO (USA); Public Service Co. of Oklahoma, Tulsa (USA); Babcock and Wilcox Co., Lynchburg, VA (USA)). 15 Jul 1980. Contract AC03-79SF10738. 46p. NTIS, PC A03/MF A01.

The Department of Energy contracted for Black and Veatch to develop a conceptual design for solar repowering Northeastern Station Unit 1 (NES 1) of the Public Service Company of Oklahoma (PSO). NES 1 is located about 50 km (30 miles) northeast of Tulsa, Oklahoma. This plant was selected because it is representative of candidate plants for repowering and for solar-fossil hybrid operation; it is located in a moderate insolation region, utilizes an efficient reheat cycle with steam conditions characteristic of modern power plants, and has sufficient land for repowering. NES 1 has a subcritical, single reheat turbine-generator and a gas-fired steam generator. The basic repowering configuration was established through a series of trade studies and the criterion that proven technology be used. The system selected has a water/steam receiver which supplies superheated steam to the turbine at a design point flow rate sufficient to displace 20 per cent of the unit's fossil fuel consumption. The hybrid nature of the plant's operation eliminates the need for costly thermal storage. A brief overview of the design, performance, and economics is given. (WHK)

34691 (DOE/SF/10738—1/2) **Solar repowering for electric generation. Northeastern Station Unit 1, Public Service Company of Oklahoma. Final report.** (Black and Veatch, Kansas City, MO (USA); Public Service Co. of Oklahoma, Tulsa (USA); Babcock and

Wilcox Co., Lynchburg, VA (USA)). 15 Jul 1980. Contract AC03-79SF10738. 292p. NTIS, PC A13/MF A01.

The conceptual design and evaluation of solar repowering and electric generating unit of Public Service Company of Oklahoma (PSO) are described in detail. The solar addition would permit, at the design point, a 20% reduction of the fossil fuel consumed by PSO's 150 MWe Northeastern Station Unit 1. The proposed system comprises a tower focus power plant with a water/steam central receiver. This volume presents the trade studies, conceptual design, system performance, economic analysis, and development plan as well as a description of a test program to determine the magnitude of impact that environmental factors have on plant design and performance. (WHK)

34692 (DOE/SF/10738—1/3) **Solar repowering for electric generation. Northeastern Station Unit 1. Public Service Company of Oklahoma.** (Black and Veatch, Kansas City, MO (USA); Public Service Co. of Oklahoma, Tulsa (USA); Babcock and Wilcox Co., Lynchburg, VA (USA)). 15 Jul 1980. Contract AC03-79SF10738. 251p. NTIS, PC A12/MF A01.

The Department of Energy contracted for Black & Veatch to develop a conceptual design for solar repowering Northeastern Station Unit 1 (NES 1) of the Public Service Company of Oklahoma (PSO). NES 1 is located about 50 km (30 miles) northeast of Tulsa, Oklahoma. This plant was selected because it is representative of candidate plants for repowering and for solar-fossil hybrid operation; it is located in a moderate insolation region, utilizes an efficient reheat cycle with steam conditions characteristic of modern power plants, and has sufficient land for repowering. NES 1 has a subcritical, single reheat turbine-generator and a gas-fired steam generator. The basic repowering configuration was established through a series of trade studies and the criterion that proven technology be used. The system selected has a water/steam receiver which supplies superheated steam to the turbine at a design point flow rate sufficient to displace 20 percent of the unit's fossil fuel consumption. This volume contains the appendices: (A) system requirements specification, and (B) daily insolation profiles. (WHK)

34693 (DOE/SF/10739—1) **Saguaro Power Plant Solar Repowering Project. Executive summary. Final technical report, September 1979-July 1980.** Weber, E.R. (Arizona Public Service Co., Phoenix (USA)). Jul 1980. Contract AC03-79SF10739. 41p. NTIS, PC A03/MF A01.

An executive summary describing the conceptual design, system performance, economics, development plan, and site owner's assessment of a solar thermal central receiver system for repowering the No. One unit of PPS's Saguaro power plant near Tuscon, Arizona, is presented. (WHK)

34694 (DOE/SF/10739—2) **Saguaro Power Plant Solar Repowering Project. Volume I. Conceptual design. Final technical report, September 1979-July 1980.** Weber, E.R. (Arizona Public Service Co., Phoenix (USA)). Jul 1980. Contract AC03-79SF10739. 355p. NTIS, PC A16/MF A01.

The conceptual design of a solar thermal central receiver repowered gas/oil fired steam-Rankine electrical power generation plant based on a central receiver using a molten salt (60% $NaNO_3$, 40% KNO_3, by wt) for repowering the No. One Unit of APS's Saguaro power plant is described in detail. The plant is located 66 km (41 mi) north of Tucson, Arizona. The selection of both the site and the molten salt central receiver promotes a near-term feasibility demonstration and cost-effective power production from an advanced solar thermal technology. The recommended system concept is to repower the existing electric power generating system at the maximum possible level (120 MW/sub e/ gross) using a field of 10,500 second-generation (49 m^2) heliostats and a storage capacity of 3.8 hours to be used for optimum dispatch of power to the utility system. The total project construction cost is estimated to be 167 million in 1980 dollars. The plant will be capable of displacing fossil energy equivalent to 4.9 million barrels of No. 6 oil in its first 10 years of operation. Detailed subsystem characteristics, an economic analysis, and a development plan are presented in detail. (WHK)

34695 (DOE/SF/10739—3) **Saguaro Power Plant Solar Repowering Project. Volume II. System requirements specification. Final technical report, September 1979-July 1980.** Weber, E.R. (Arizona Public Service Co., Phoenix (USA)). Jul 1980. Contract AC03-79SF10739. 50p. NTIS, PC A03/MF A01.

This specification defines the system and subsystem characteristics, design requirements, and system environmental requirements for the Saguaro Power Plant Solar Repowering Project. This project involves the solar repowering of all (120.2 MWe gross) of the 115 MWe net power No. One steam-Rankine unit of the Arizona Public Service Company's Saguaro station. The receiver heat transport fluid is draw salt (60% sodium nitrate and 40% potassium nitrate) that is also used to provide 3.8 hours of sensible heat thermal energy storage. The quad-cavity type receiver is mounted on a tower within a single surrounding collector field of 10,500 second generation heliostats.

34696 (DOE/SF/10739—4) **Saguaro Power Plant Solar Repowering Project. Volume III. Appendices. Final technical report, September 1979-July 1980.** Weber, E.R. (Arizona Public Service Co., Phoenix (USA)). Jul 1980. Contract AC03-79SF10739. 304p. NTIS, PC A14/MF A01.

The conceptual design of a central receiver power plant using a molten salt for repowering the No. One Unit of Arizona Public Service's Saguaro power plant is given. This volume of the report contains the appendices: (A) effect of Arizona Public Service Company's demand profile on the amount of storage; (B) receiver design drawings; (C) plant characteristics and performance data; (E) existing plant description; (F) economic data; (G) simulation models; (H) plant cost data; and (I) project control network. (WHK)

34697 (DOE/SF/10740—1(Vol.1)) **Newman Unit 1 solar repowering. Final report.** (El Paso Electric Co., TX (USA)). Jul 1980. Contract AC03-79SF10740. 367p. NTIS, PC A16/MF A01.

The principal objective of this study was to develop a conceptual design and cost estimate for solar repowering El Paso Electric Company's Newman Unit 1 that has the potential for construction and operation by 1985, makes use of existing solar thermal technology, and provides the best economics for this application. Specific objectives were: (1) to prepare a systems specification for solar repowering Newman Unit 1, (2) to select a preferred configuration and prepare a conceptual design, (3) to establish the performance and economic attractiveness of solar repowering design, and (4) to prepare a development plan for a demonstration program at Newman Station. This volume contains the detailed conceptual design, economic analysis, and development plan. The preferred system consists of a 160° array of heliostats and an advanced water/steam receiver. (WHK)

34698 (DOE/SF/10740—1(Vol.1)(Exect.Summ)) **Newman Unit 1 solar repowering. Final report, Volume 1A.** (El Paso Electric Co., TX (USA)). Jul 1980. Contract AC03-79SF10740. 43p. NTIS, PC A03/MF A01.

The principal objective of this study was to develop a conceptual design and cost estimate for solar repowering El Paso Electric Company's Newman Unit 1 that has the potential for construction and operation by 1985, makes use of existing solar thermal technology, and provides the best economics for this application. Specific objectives were: (1) to prepare a systems specification for solar repowering Newman Unit 1, (2) to select a preferred configuration and prepare a conceptual design, (3) to establish the performance and economic attractiveness of solar repowering design, and (4) to prepare a development plan for a demonstration program at Newman Station. This volume contains the executive summary. (WHK)

34699 (DOE/SF/10740—1(Vol.2)) **Newman Unit 1 solar repowering. Final report.** (El Paso Electric Co., TX (USA)). Jul 1980. Contract AC03-79SF10740. 84p. NTIS, PC A05/MF A01.

This specification defines the system and subsystem characteristics, design requirements, and system environmental requirements for solar repowering of Newman Unit 1 which is operating on the El Paso Electric Company (EPE) system. This unit has a reheat steam turbine rated to produce 82 MWe with a 10.1 Pa/538°C (1450 psig/1000°F) main steam conditions and a 2.93 MPa/538°C (410 psig/1000°F) reheat steam conditions. The solar subsystem will be designed to supply steam in sufficient quantity and quality to generate 50 percent of the rated electrical power at the design point of noon summer solstice. It will operate in parallel with the present gas/oil fired boiler. In general, the level of detail presented in this specification is consistent with the conceptual design phase of a large power plant project. Engineering information is developed to the extent necessary to support the development of a conceptual plant cost estimate and the determination of technical and economic feasibility of the project.

34700 (DOE/SF/10740—1(Vol.3)) **Newman Unit 1 solar repowering. Final report.** (El Paso Electric Co., TX (USA)). Jul 1980. Contract AC03-79SF10740. 43p. NTIS, PC A03/MF A01.

The principal objective of this study was to develop a conceptual design and cost estimate for solar repowering El Paso Electric Company's Newman Unit 1 that has the potential for construction and operation by 1985, makes use of existing solar thermal technology, and provides the best economics for this application. Specific objectives were: (1) to prepare a systems specification for solar repowering Newman Unit 1, (2) to select a preferred configuration and prepare a conceptual design, (3) to establish the performance and economic attractiveness of solar repowering design, and (4) to prepare a development plan for a demonstration program at Newman Station. This volume contains the conceptual design drawings for the proposed system. (WHK)

34701 (DOE/SF/10741—1(Exec.Summ.)) **Southwestern Public Service Company Solar Repowering Program. Final technical report.** (General Electric Co., Schenectady, NY (USA). Energy Systems

Programs Dept.). Jul 1980. Contract AC03-79SF10741. 29p. NTIS, PC A03/MF A01.

The conceptual design, performance, economics, and development plan for solar repowering the gas-fired power plant Plant X owned by the Southwest Public Service Company and located south of Amarillo, Texas, are described. The conceptual design comprises a tower focus power plant with a 212-acre collector field and uses liquid sodium heat transfer fluid. (WHK)

34702 (DOE/SF/10741—1(Vol.1)) **Southwestern Public Service Company Solar Repowering Program. Volume 1. Conceptual design and evaluation. Final technical report.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Jul 1980. Contract AC03-79SF10741. 339p. NTIS, PC A15/MF A01.

The detailed conceptual design, subsystem characteristics, economic analysis, development plan, and user's assessment of repowering Southwest Public Service Company's Plant X located south of Amarillo, Texas, with a tower focus power plant are presented. The plant will utilize liquid sodium heat transfer fluids, thermal storage tanks, and a steam generator/turbine. Detailed economic and cost data are included. (WHK)

34703 (DOE/SF/10741—1(Vol.2)) **Southwestern Public Service Company Solar Repowering Program. Volume II. Appendixes. Final technical report.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Jul 1980. Contract AC03-79SF10741. 281p. NTIS, PC A13/MF A01.

A design study for repowering the Southwestern Public Service Company's Plant X with a 60 MWe liquid sodium tower focus power plant is presented. This volume contains the appendices: (A) system requirements specification for the Southwestern Public Service Company solar repowering; (B) sodium pressure drop calculations; (C) calculation of auxiliary power requirements; (D) utility system production costing-monthly production simulation program; (E) absorber panel tube joint analysis; (F) repowering panel tube joint analysis; (G) electromagnetic/centrifugal pump tradeoff study; (H) report of X-3 reheater test; (I) example screening curve computation and solar repowering plant busbar cost; (J) loss-of-load probability methodology and solar thermal-electric plant capacity credit; (K) helical coil steam generator evaluation; and (L) Southwestern Public Service Company solar repowering community endorsements. (WHK)

34704 (DOE/SF/10741—2) **Mathematical representation of the solar repowering steam generator.** Meyer, D.J. (General Electric Co., Schenectady, NY (USA). Advanced Reactor Systems Dept.). Sep 1980. Contract AC03-79SF10741. 81p. NTIS, PC A05/MF A01.

A mathematical model has been developed to simulate the performance of the solar repowering liquid sodium heated steam generator. The model is in the form of discrete finite difference equations which describe the thermal performance and pressure drops to be expected for the steam generator under steady state and transient conditions at full or part load. Steam generation is described in five nodes: liquid preheat, sub-cooled nucleate boiling, nucleate boiling, film boiling and superheating. Heat exchange between the liquid sodium and steam is modeled in three regions: near the water inlet where the sodium is stagnant, in the central section where the sodium and steam flows are counter-current, and in the upper curved section where a small vent flow of sodium is co-current with the steam flow. Appropriate heat transfer correlations are included for both the sodium and steam sides of the steam generator.

34705 (SAND—80-7060) **Solar total energy modularity study.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Aug 1980. Contract AC04-76DP00789. 203p. NTIS, PC A10/MF A01.

This is the final report of the McDonnell Douglas Astronautics Company's work on the Solar Total Energy Modularity Study. It presents the results of a 26-month study which included the survey of industrial sites to obtain site-specific energy demand data and other information pertinent to designing solar total energy systems for the sites. Solar systems, using single-axis tracking parabolic-trough solar collectors were designed for each of the sites to the depth necessary to verify feasibility and identify major system components. Cost and performance estimates for each of the systems were estimated and used to predict internal rate of return over a range of collector cost and performance. Parametric system and component performance data are presented along with solar insolation data for all the Sol-Met data stations which allows the rapid assessment of solar system feasibility for future potential industrial users.

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 34765

34706 (DOE/ET/21002—9) **OTEC support services. Quarterly technical progress report No. 9, 15 May-14 August 1980.** (VSE Corp., Alexandria, VA (USA)). Aug 1980. Contract AC02-78ET21002. 22p. NTIS, PC A02/MF A01.

System integration, system engineering, and management support services provided by the VSE Corporation for the Ocean Thermal Energy Conversion Program of the Ocean Systems Branch, Division of Central Solar Technology, DOE are described. The services are provided under seven task areas: (1) survey, analysis, evaluation, and recommendation concerning program performance; (2) program technical monitoring; (3) development and implementation of methodology to identify and evaluate program alternatives; (4) technical assignments; (5) OTEC system integration; (6) environment and siting considerations; and (7) transmission subsystem considerations. (WHK)

34707 (PB—80-120595) **Data from OTEC site characterization studies in the Gulf of Mexico and tropical South Atlantic. Technical memo.** Molinari, R.L.; Hazelworth, J.B.; Ortman, D.A. (National Oceanic and Atmospheric Administration, Miami, FL (USA). Atlantic Oceanographic and Meteorological Labs.). Sep 1979. 266p. NTIS, PC A12/MF A01.

This report presents data collected at the Mobile site, and west of Tampa, Florida, and in the tropical South Atlantic. The objectives of these data reports are to give data reduction techniques and lists and plots of the data. A table shows the data collection effort conducted at the three sites from January through December 1978. Another table lists the area, vessel and data collected during each site visit. A third table lists the type of positioning used by each vessel and the accuracy of each system. Station positions are shown. The analysis techniques applied to each data-set are described. Listing and figures for each set are given in appendices. In addition a summary of the limited amount of meteorological data collecting during the site visits is given.

34708 (PB—80-802580) **Solar sea power plants (citations from the NTIS data base). Report for 1964-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 314p. NTIS PCN01/MF N01.

Federally-funded research studies dealing with the technical and economic feasibility of solar sea power plants are discussed. Topic areas cover condenser, evaporator, and heat exchanger design; and fouling and corrosion prevention. Included are a few abstracts pertaining to site selection, dynamic modeling studies, and general studies dealing with solar sea power as an energy alternative. (This updated bibliography contains 307 abstracts, 97 of which are new entries to the previous edition.)

34709 (PB—80-802598) **Solar sea power plants (citations from the Engineering Index data base). Report for 1970-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 257p. NTIS PCN01/MF N01.

The present status and future prospects of using the ocean thermal gradient for production of electric power are discussed in these citations from worldwide research. Engineering, economic, and feasibility studies are covered, including studies dealing with systems and component design. (This updated bibliography contains 250 abstracts, 126 of which are new entries to the previous edition.)

34710 (SERI/TP—631-791) **Open cycle OTEC system with falling jet evaporator and condenser.** Kogan, A.; Johnson, D.H.; Green, H.J.; Olson, D.A. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-76CH00178. 11p. (CONF-800633—3). NTIS, PC A02/MF A01.

From 7. ocean energy conference; Washington, DC, USA (2 Jun 1980).

A configuration for the open cycle (OC) Ocean Thermal Energy Conversion (OTEC) system is presented incorporating a countercurrent falling jet evaporator and a concurrent falling jet condenser. The parameters governing performance of the proposed configuration are discussed and the sizing of equipment for a 100-MWe net power output OC OTEC plant is performed, based on recent experimental falling jet heat and mass transfer results. The performance of an OC OTEC plant with falling jet evaporator-condenser is compared with the Westinghouse conceptual design that uses an open-channel evaporator and a surface condenser. Preliminary calculations indicate that falling jet heat and mass transfer, when applied in the proposed configuration, leads to a very simple and compact plant assembly resulting in substantial capital cost savings.

34711 **Ocean engineering for OTEC, presented at energy-sources technology conference and exhibition, 1980.** Griffin, O.M.; Giannotti, J.G. (eds.). New York, NY; American Society of Mechanical Engineers (1979). 87p.

From Energy-sources technology conference and exhibition; New Orleans, LA, USA (3-7 Feb 1980).

This conference contains 6 papers, all of which are abstracted separately. The subject matter is concerned with one of the major

problem areas--ocean engineering--that presently hinders commercial-scale utilization of ocean thermal energy conversion (or OTEC, as it is now popularly known). The main platform and mooring systems of the OTEC plant and the long, slender pipe that is required to raise cold water from the ocean depths are three major ocean engineering problems to be overcome. Three of the papers in this volume deal with the design and testing of the OTEC cold water pipe and three papers deal with the prediction of the forces on the motions of the OTEC platform and pipe.

34712 NOAA's cold-water pipe at-sea test program. Pompa, J.A.; Komelasky, M.C.; Schneider, J.M.; Buck, J.R. (ORI, Inc, Silver Spring, Md). pp 1-6 of Ocean engineering for OTEC, presented at energy-sources technology conference and exhibition, 1980. Griffin, O.M.; Giannotti, J.G. (eds.). New York, NY; American Society of Mechanical Engineers (1979).

From Energy-sources technology conference and exhibition; New Orleans, LA, USA (3-7 Feb 1980).

This paper presents a detailed description of the organizational structure involved with the CWP At-Sea Test Program, detailing the Test Integration Management role in coordinating the various activities of the Test Engineering Group, and maintaining liaison between NOAA's Office of Ocean Engineering and the numerous participants in this project. Further, the plan for utilization of the data to be collected for validation of the NOAA/ DOE CWP Analytic Model is presented, identifying the necessary environmental and structural loading parameters to be measured. Finally, a progress report on the status of the test program is presented, concentrating on significant accomplishments to date as well as difficulties that have been encountered and the schedule changes or important variances in the program plan that these factors have induced. 4 refs.

34713 NOAA/DOE frequency-domain methods for analysis for OTEC plant CWP and CWP/platform static and dynamic responses. Chang, P.Y.; Barr, R.A. (Hydronaut, Inc, Laurel, Md). pp 7-20 of Ocean engineering for OTEC, presented at energy-sources technology conference and exhibition, 1980. Griffin, O.M.; Giannotti, J.G. (eds.). New York, NY; American Society of Mechanical Engineers (1979).

From Energy-sources technology conference and exhibition; New Orleans, LA, USA (3-7 Feb 1980).

This paper describes a state-of-the-art method for analyzing the at-sea dynamic and static behavior of OTEC plant cold water pipe (CWP) and platform/CWP designs. This frequency domain method treats the CWP as a linear elastic beam and considers the full coupling between the CWP and the platform. The method and associated computer programs have been fully documented and delivered to NOAA for delivery to and use by qualified DOE and NOAA contractors. The paper considers the nature of the method, its capabilities, its validation and some relative merits of frequency-domain and time-domain methods. 13 refs.

34714 Structural analysis of a cold water pipe for a 40MWe spar OTEC platform. Jawish, W.K. III; Deuchler, W.P. (Giannotti and Assoc, Inc, Annapolis, Md). pp 29-46 of Ocean engineering for OTEC, presented at energy-sources technology conference and exhibition, 1980. Griffin, O.M.; Giannotti, J.G. (eds.). New York, NY; American Society of Mechanical Engineers (1979).

From Energy-sources technology conference and exhibition; New Orleans, LA, USA (3-7 Feb 1980).

One of the key technological issues in the Ocean Thermal Energy Conversion (OTEC) program of DOE is the ability to design, construct, and deploy a cold water pipe which will survive the environmental conditions to which it will be exposed throughout its lifetime. Present studies related to the cold water pipe (CWP) indicate that the expected environmental loads and structural responses are so severe that the CWP is perhaps the most serious technological program in the entire OTEC concept. The purpose of this paper is to present a methodology for predicting the overall and local loads and stresses acting on the CWP and to show how these results can be implemented in a structurally sound design. 11 refs.

34715 At-sea test of a large diameter steel, cold water pipe. Blevins, R.W.; Donnelly, H.L.; Stadter, J.T.; Weiss, R.O.; Perez y Perez, L. (Johns Hopkins Univ, Laurel, Md). pp 47-65 of Ocean engineering for OTEC, presented at energy-sources technology conference and exhibition, 1980. Griffin, O.M.; Giannotti, J.G. (eds.). New York, NY; American Society of Mechanical Engineers (1979).

From Energy-sources technology conference and exhibition; New Orleans, LA, USA (3-7 Feb 1980).

A series of tests were conducted off Santa Catalina Island, California, on a large-diameter steel pipe. The pipe was 5 ft in diameter and made up in 20-ft sections to obtain a total length up to 500 ft (152.4 m). Deep Oil Technology's X-1 semi-submersible platform was used to support the pipe through a gimbal joint and the platform was moored with spring buoys in 1000 ft (304.8 m) of water. The objectives were to evaluate the at-sea performance of various configurations and to use the test results to verify or improve existing time and frequency domain analyses of cold-water pipes for Ocean Thermal Energy Conversion (OTEC) plants. 4 refs.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 34742, 34751

34716 (TAC-STC—80-001) **Solar thermal components: a bibliography with abstracts. Quarterly update, January-March 1980.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jun 1980. 222p. Univ. of New Mexico, Albuquerque.

This annotated bibliography covers the following subjects: material properties, flat-plate collectors; concentrating collectors; heat pumps, coolers, heat exchangers, solar ponds, distillation, process heat, and irrigation pumps. An author index and a keyword index are included. (MHR)

34717 (TAC-STHC—80-001) **Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, January-March 1980.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). May 1980. 218p. Univ. of New Mexico, Albuquerque.

This annotated bibliography covers the following subjects: demonstrations; system overviews; computer designs, models, and simulations; thermal storage; architectural considerations; passive solar energy; solar air conditioning and cooling; solar water heating; solar radiation, instruments; and monitoring systems; swimming pools; greenhouses; and control systems. An author index and a keyword index are included. (MHR)

34718 (TAC-STHC—80002) **Solar thermal heating and cooling: a bibliography with abstracts. Quarterly update, April-June 1980.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jul 1980. 163p. Univ. of New Mexico, Albuquerque, NM.

This annotated bibliography covers the following subjects: demonstrations; system overviews; computer designs, models, and simulations; thermal storage; architectural considerations; passive solar energy; air conditioning and cooling; domestic water heating; insolation; instruments, and monitoring systems; swimming pools, greenhouses, and control systems. (MHR)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 34739, 34756, 34759, 34760, 34762, 35070

34719 (DOE/CS/34136—1) **Experimental and theoretical study of thermal performance of a hybrid solar system at Living History Farms. Final report, September 19, 1977-August 31, 1980.** (Ames Design Collaborative, IA (USA)). 1980. Contract FG04-77CS34136. 28p. NTIS, PC A03/MF A01.

This report chronicles the development and study of the salt gradient solar pond and hybrid solar house at the Farm of Today and Tomorrow at Living History Farms. The background of the project is given and includes conceptualization to present status. The construction history is summarized. The instrumentation and experimental results from the solar pond are discussed, as well as conclusions in regard to solar pond operation and gradient zone stability. To date the solar pond has operated for over a year and has supplied interesting experimental observations about stability of the salt gradient. The solar house is still under construction.

34720 (DOE/NASA/CR—161513) **Solar heating and domestic hot water system installed at Kansas City, Fire Station, Kansas City, Missouri. Final report.** (Kansas City, City of, MO (USA)). Jul 1980. Contract AC01-76CS32373;AI01-76CS31037. 157p. NTIS, PC A08/MF A01.

This document is the final report of the solar energy heating and hot water system installed at the Kansas City Fire Station, Number 24, 2309 Hardesty Street, Kansas City, Missouri. The solar system was designed to provide 47 percent of the space heating, 8800 square feet area and 75 percent of the domestic hot water (DHW) load. The solar system consists of 2808 square feet of Solaron, model 2001, air, flat plate collector subsystem, a concrete box storage subsystem which contains 1428 cubic feet of 1/2 inch diameter pebbles weighing 71 1/2 tons, a DHW preheat tank, blowers, pumps, heat exchangers, air ducting, controls and associated plumbing. Two 120-gallon electric DHW heaters supply domestic hot water which is preheated by the solar system. Auxiliary space heating is provided by three electric heat pumps with electric resistance heaters and four 30-kilowatt electric unit heaters. There are six modes of system operation. This project is part of the Department of Energy PON-1 Solar Demonstration Program with DOE cost sharing $154,282 of the $174,372 solar system cost. The Final Design Review was held March 1977, the system became operational March 1979 and acceptance test was completed in September 1979.

34721 (DOE/NASA/TM—78291) **Solar site test module.** Kissel, R.R.; Scott, D.R. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Jul 1980. Contract AI01-76CS31037. 32p. NTIS, PC A03/MF A01.

A solar site test module using the Rockwell AIM 65 microcomputer is described. The module is designed to work at any site where an IBM site data acquisition system (SDAS) is installed and is intended primarily as a troubleshooting tool for DOE/NASA commercial solar heating and cooling system demonstration installations. It collects sensor information (temperatures, flow rates, etc.) and displays or prints it immediately in calibrated engineering units. It will read one sensor on demand, periodically read up to 10 sensors or periodically read all sensors. Performance calculations can also be included with sensor data. Unattended operation is possible to, e.g., monitor a group of sensors once per hour. Work is underway to add a data acquisition system to the test module so that it can be used at sites which have no SDAS.

34722 (DOE/NASA/TM—78293) **Three computer codes to read, plot, and tabulate operational test-site recorded solar data.** Stewart, S.D.; Sampson, R.J. Jr.; Stonemetz, R.E.; Rouse, S.L. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Jul 1980. Contract AI01-76CS31037. 89p. NTIS, PC A05/MF A01.

A computer program, TAPFIL, has been developed by MSFC to read data from an IBM 360 tape for use on the PDP 11/70. The information (insolation, flowrates, temperatures, etc.) from 48 operational solar heating and cooling test sites is stored on the tapes. Two other programs, CHPLOT and WRTCNL, have been developed to plot and tabulate the data. These data will be used in the evaluation of collector efficiency and solar system performance. This report describes the methodology of the programs, their inputs, and their outputs.

34723 (LA-UR—80-2267) **Quantitative comparison of passive solar simulation codes.** Wray, W.O. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—8). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

Several members of the Systems Simulation and Economic Analysis (SS/EA) Working Group have participated in a software-software comparison of passive solar simulation codes. The problems selected and defined by the Los Alamos Scientific Laboratory (LASL) for analysis include both a vented and an unvented Trombe wall and a direct gain building. The individuals, organizations, and associated computer models involved in this exercise are Byron Wynn, Colorado State University (CSU) (FREHEAT); Larry Palmiter, National Center for Appropriate Technology (NCAT) (SUNCAT); Bill Beckman, the University of Wisconsin (WIS) (TRNSYS); Bill Wray, LASL (PASOLE, SUNSPOT); and John Moore, LASL (DOE-2). Each of these organizations submitted simulation results to LASL, where a comparative analysis was conducted. Excellent agreement was achieved on annual auxiliary heat loads, but several detailed heat fluxes within the structures showed significant scatter, as did both the ventilation and auxiliary cooling.

34724 (LA-UR—80-2340) **Passive solar design calculations with the DOE-2 computer program.** Kerrisk, J.F.; Moore, J.E.; Schnurr, N.M.; Hunn, B.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—6). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

The DOE-2 computer program has been modified to improve modeling of passive-solar buildings by the addition of the custom weighting-factor method. The thermal-load and air-temperature calculation procedure in DOE-2 are described. Assumptions inherent in the use of American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) precalculated and the custom weighting factors are discussed. Calculated results from DOE-2 are compared with measured heat-extraction rates and air temperatures for four buildings. These comparisons indicate that DOE-2 can accurately model direct-gain passive buildings and can treat night-ventilative cooling and water walls in an approximate manner.

34725 (LA-UR—80-2428) **Market potential indexing for passive solar heating: single family new construction in the Mid-American Region.** Robson, W.M.; Yeamans, M.; Noll, S.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-801016—4). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

The US Department of Energy (DOE) and the Regional Solar Energy Centers expressed need for a technique to evaluate the relative market potentials of various solar technologies on a city specific basis. A methodology for evaluating the comparative market potentials of the 220 SOLMET regions defined in the Los Alamos Scientific Laboratory (LASL) and University of New Mexico (UNM) EASE III code is discussed. The methodology Market Potential Indexing, (MPI) is based on the commonly used management science technique of multi-attribute decision analysis. The MPI methodology, the selection of attributes and weighting factors, and the development of the data bases for the model are described. Preliminary results for an MPI study of the Mid-America Solar Region are included.

34726 (PB—80-108624) **Solar ponds for residential heating, heat extraction from a salt gradient solar pond. Final report, 19 August 1976-30 June 1977.** Zangrando, F.; Bryant, H.C. (New Mexico Univ., Albuquerque (USA). Dept. of Physics and Astronomy). Jul 1979. 41p. NTIS, PC A03/MF A01.

A salt gradient solar pond is an efficient, low cost solar energy collection and long range storage system for low temperature heat. The object of the research is to establish operational parameters, selection criteria for the materials to be used, cost, and performance, as well as to study the physical behavior of doubly-diffusive systems exposed to the environment.

34727 (SERI/RR—721-675) **Investigation of simple daily solar radiation models suitable for use in the design of solar heating systems.** Sillman, S. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1980. Contract AC02-77CH00178. 50p. NTIS, PC A03/MF A01.

Solar heating system simulations typically require hourly weather data and the use of a main-line computer. A simpler alternative is to use daily steps with a model for daily solar collection. This report investigates the accuracy of sinusoidal radiation models for use in solar heating simulation. Accuracy of daily radiation models is assessed in two ways: by a theoretical comparison with hourly weather data, and by analysis of results of daily simulation. Results indicate that a daily radiation model can be designed with errors of less than 2%.

34728 (SOLAR/0001—80-15) **Instrumentation installation guidelines. Part 3. Installation kit instructions.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1 Jul 1980. Contract AC01-79CS30027. 32p. NTIS, PC A03/MF A01.

The National Solar Data Network (NSDN) establishes the performance of selected residential and commercial solar demonstration projects. This is done by installing an instrumentation system in a solar system that monitors its operating characteristics (temperatures, flow rates, power usage, etc.). This data is collected, analyzed, and the results are published and made available for public use as aids for further solar development. This document identifies the various activities which must be performed in instrumenting solar systems. The Instrumentation Installation Guidelines (IIG) also defines the required responsibilities of DOE, the NSDN Contractor, and the site contractor. Active communications between each NSDN participant can ensure that a good instrumentation system will be installed. This will render useful data to engineers, designers, contractors, manufacturers, and others to further promote solar energy applications.

34729 (SOLAR/0001—80-15(Pt.1)) **Instrumentation installation guidelines. Part 1. Program outline.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1 Jul 1980. Contract AC01-79CS30027. 42p. NTIS, PC A03/MF A01.

The National Solar Data Network (NSDN) establishes the performance of selected residential and commercial solar demonstration projects. This is done by installing an instrumentation system in a solar system that monitors its operating characteristics (temperatures, flow rates, power usage, etc.). This data is collected, analyzed, and the results are published and made available for public use as aids for further solar development. A systematic approach is used to develop data requirements, instrumentation techniques, and analysis methods. This ensures uniform data collection from each site. Instrumentation and technical evaluation of each solar system, building, and climate combination is not practical on all government sponsored demonstration sites. Only selected installation meeting DOE guidelines in various US geographic locations will be instrumented. This document describes the sensor installations to be performed by the site contractor for his specific site. The sensors are to be installed as shown in the sensor installation instructions. The instructions and the site drawing will identify the sensor, show how it is physically installed and where to install it. Appendix A, the site specific installation kit will also be packed in the junction box and contains instructions for making the electrical connections from the sensor to its instrumentation cable and from the cable to the junction box.

34730 (SOLAR/0001—80-15(Pt.2)) **Instrumentation installation guidelines. Part 2. Approved instrumentation plan and cost guide.** (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1 Jul 1980. Contract AC01-79CS30027. 39p. NTIS, PC A03/MF A01.

The National Solar Data Network (NSDN) establishes the performance of selected residential and commercial solar demonstra-

tion projects. This is done by installing instrumentation in a solar system that monitors its operating characteristics (temperatures, flow rates, power usage, etc.). This data is collected, analyzed, and the results are published and made available for public use as aids for further solar development. A systematic approach is used to develop data requirements, instrumentation techniques, and analysis methods. This ensures uniform data collection from each site. This document, Part 2 of the Instrumentation Installation Guidelines (IIG) is the Approved Instrumentation Plan (AIP). The AIP provides the site contractor with the information required to install and maintain instrumentation as well as provide an estimate of the cost required to perform this work. In this part of the NSDN program the site contractor forwards his project instrumentation plan to DOE and the NSDN contractor and his completed cost estimate to DOE.

34731 Performance effects of Trombe wall control strategies. Sebald, A.V.; Clinton, J.R.; Langenbacher, F. (Univ of Calif, San Diego). *Sol. Energy;* **23**: No. 6, 479-487(1979).

Trombe wall performance is analyzed for a variety of control strategies in Albuquerque, New Mexico, Santa Maria, California and Madison, Wisconsin. Controls were considered in both the presence and absence of backup energy. The analysis was performed using hourly simulations on Solmet weather data in a thermal network model. Sensitivity of the results to wall thickness and size, building azimuth and house insulation levels is computed. Proper controls were found to reduce backup requirements as much as 50%. Alternatively, they appear to provide equivalent solar fractions with thinner and smaller walls. Finally, in the absence of backup energy, proper controls on thin walls provide better performance than standard walls of double thickness. 12 refs.

34732 Passive collection of solar energy in buildings. London, England; International Solar Energy Society (1979). 92p. (CONF-7904148—).

From Conference on passive collection of solar energy in buildings; London, UK (24 Apr 1979).

The nine papers presented were entered into the data base separately. (WHK)

34733 Passive solar heating for buildings. Balcomb, J.D. (Los Alamos Scientific Lab., NM). pp 75-85 of Passive collection of solar energy in buildings. London, England; International Solar Energy Society (1979).

From Conference on passive collection of solar energy in buildings; London, UK (24 Apr 1979).

A passive solar energy system is one in which the thermal energy flow is by natural means, that is by radiation, conduction, or natural convection. A survey of passive solar heating experience, especially in the US is provided. Design approaches are reviewed. Misconceptions are discussed. Advantages are listed. The Los Alamos program of performance simulation and evaluation is described and a simplified method of performance estimation is outlined.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 34761

34734 (DOE/NASA/CR—161537) **Solar hot water demonstration project at Red Star Industrial Laundry, Fresno, California.** (Aratex Services, Inc., Encino, CA (USA)). Jul 1980. Contract AC01-76CS32384. 81p. NTIS, PC A05/MF A01.

The Final Report of the Solar Hot Water System located at the Red Star Industrial Laundry, 3333 Sabre Avenue, Fresno, California, is presented. The system was designed as an integrated wastewater heat recovery and solar preheating system to supply a part of the hot water requirements. It was estimated that the natural gas demand for hot water heating could be reduced by 56 percent (44 percent heat reclamation and 12 percent solar). The system consists of a 16,500 gallon tube-and-shell wastewater heat recovery subsystem combined with a pass-through 6,528 square foot flat plate Ying Manufacturing Company Model SP4120 solar collector subsystem, a 12,500 gallon fiber glass water storage tank subsystem, pumps, heat exchangers, controls, and associated plumbing. The design output of the solar subsystem is approximately 2.6×10^9 Btu/year. Auxiliary energy is provided by a gas fired low pressure boiler servicing a 4,000 gallon service tank. This project is part of the US Department of Energy's Solar Demonstration Program with DOE sharing $184,841 of the $260,693 construction cost. The system was turned on in July 1977, and acceptance tests completed in September 1977. The demonstration period for this project ends September 2, 1982.

34735 (PB—80-804248) **Solar drying of crops and food (citations from the Engineering Index data base). Report for 1970-January 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 107p. NTIS PC N01/MF N01.

Abstracts from worldwide literature discuss design and performance of solar collectors for crop drying applications, crop drying in bins with solar heated air, energy requirements for crop drying, and solar dryers supplemented with auxiliary heating systems. (This updated bibliography contains 100 abstracts, 38 of which are new entries to the previous edition.)

34736 (SAN—1882-1) **Solar production of industrial process steam. Phase 1: analysis and design.** (Pacific Sun, Inc., Palo Alto, CA (USA)). 1 Oct 1979. Contract EM-78-C-03-1882. 284p. NTIS, PC A13/MF A01.

The conceptual design of an intermediate temperature, solar industrial process heat system to be installed at the Stauffer Chemical Company's Industrial Chemical Division Plant in Henderson, Nevada, is presented. The plant is involved in the manufacture of chlorine and caustic soda. The IPH system features a 10,592 ft^2 (984 m^2) array of linear parabolic concentrating collectors manufactured by Suntec Systems, Inc. The array bheats pressurized treated water directly. A thermodynamic flashing process is used to produce saturated steam at 368°F (187°C) and 170 psia (1.172 MPa). This steam is supplied to the main distribution network in the Henderson plant at a maximum mass flow rate of approximately 2,000 lbm/h (910 kg/h). The various thermodynamic approaches considered for solar steam generation are outlined, and the characteristics of the flash-separation process are detailed. The performance of the system, as predicted by a TRNSYS-based, time-dependent simulation program is presented. System economics, environmental impact, and safety considerations are discussed. (WHK)

34737 Campbell's cans are solar cleaned. HEss, M. *Sol. Heat. Cool.;* **5**: No. 5, 16(May 1980).

A solar water heating system which collects energy for washing cans at the Campbell Soup Company plant in Sacramento, CA is described. The system is comprised of 54 flat plate collectors that preheat well water to 140°F, and 48 parabolic concentrating collectors that further heat the water to 195°F. The system also has a tracking capability and a 19,000 gallon steel accumulator storage tank. (SPH)

34738 Industrial process heat. GE's system at Riegel Textile Corp.: another first. Trice, J.B. (General Electric Co., Philadelphia, PA). *Sol. Age;* **4**: No. 3, 22-24(Mar 1979).

A solar collecting system built to provide industrial process hot water to a textile plant in South Carolina is described. The system was built by GE and heats water in an open fabric-dyeing vat. It has been designed to provide 50 to 70% of the process heat required for a single unit. System performance and energy savings data calculated with a solar energy system simulation computer program are presented. (SPH)

WATER HEATING

REFER ALSO TO CITATION(S) 34719, 34720, 34759, 34762

34739 (DOE/NASA/CR—161538) **Solar energy system demonstration project at Wilmington Swim School, New Castle, Delaware. Final report.** (Cooperson Brack Associates, Montchanin, DE (USA)). Jul 1980. Contract EM-78-F-01-5190. 95p. NTIS, PC A05/MF A01.

This document is the Final Report of the Solar Energy System located at the Wilmington, Swim School, New Castle, Delaware. This active solar system is composed of 2,700 square feet of Revere liquid flat plate collectors piped to a 2,800 gallon concrete storage tank located below ground near the building. A microcomputer based control system selects the optimal applications of the stored energy among space, domestic water and pool alternatives. The controlled logic is planned for serving the heat loads in the following order: space heat-new addition, domestic water-entire facility, and pool heating-entire facility. A modified trombe wall passive operation the active system will bypass the areas being served passively. The system was designed for a 40 percent heating and a 30 percent hot water solar contribution.

OTHER

REFER ALSO TO CITATION(S) 34735

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 34716

34740 (AD-A—078653/3) **Solar-powered sun tracker. Final report feb 77-sep 79.** Ward, C.J. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Jun 1979. 33p. NTIS, PC AA03/MF A01.

A solar-powered sun tracker believed to be capable of repositioning equipment to within 1 degree of the angle-of-incident radiation is described in this report. The proposed tracker is designed to

reposition itself automatically after cloudy periods and should prove inexpensive as well as reliable. Included in this report are (1) a description of two tracker concepts, (2) a derivation of the heat-balance equation used to predict work available for equipment rotation, (3) a discussion of the experimental model fabricated to prove concept feasibility, and (4) an economic analysis comparing the cost of generating steam with a solar-powered boiler with the cost of generating steam with a coal-fired boiler. (Author)

34741 (DOE/AL/04181—T1) **Optimized concentrating/passive tracking solar collector. Final report.** Sterne, K.E.; Johnson, A.L.; Grotheer, R.H. (Mithra Co., Irvine, CA (USA)). Jan 1979. Contract FG04-78AL04181. 79p. NTIS, PC A05/MF A01.

A concentrating solar collector having about half the material cost of other collectors with similar performance is described. The selected design is a Compound Parabolic Concentrator (CPC) which concentrates solar energy throughout the year without requiring realignment. Output is a fluid heated to 100°C with good efficiency. The optical design of the reflector surface was optimized, yielding a 2.0:1 concentration ratio with a 60°C acceptance angle and a low profile. Double glazing was chosen consisting of a polyester film outer glazing and an inner glazing of glass tubes around the absorbers. The selectively coated steel absorber tubes are connected in series with flexible plastic tubing. Much development effort went into the materials for the reflector subassembly. A laminate of metalized plastic film over plaster was chosen for the reflective surface. The reflector is rigidized by attaching filled epoxy header plates at each end. Aluminum side rails and an insulating back complete the structure. The finished design resulted in a material cost of $21.40 per square meter in production quantities. Performance testing of a prototype produced a 50% initial efficiency rating. This is somewhat lower than expected, and is due to materials and processes used in the prototype for the outer glazing, reflective surface and absorber coating. However, the efficiency curve drops only slightly with increasing temperature differential, showing the inherent advantage of the concentrator over flat plate collectors.

34742 (DOE/CS/30118—T3) **Status Report of Solar Standards coordinated by the Steering Committee on Solar Energy Standards Development contents.** (American National Standards Inst., New York). 18 Aug 1980. Contract AC01-79CS30118. 33p. NTIS, PC A03/MF A01.

Solar standards are listed for each of the standards writing organizations associated with the Steering Committee. A complete list of approved standards, standards under development, and standards under revision is provided. (WHK)

34743 (DOE/CS/31072—T2) **Study of aluminum corrosion in aluminum solar heat collectors using aqueous glycol solution for heat transfer. Annual technical progress report, July 30, 1979-July 31, 1980.** Wong, D.; Cocks, F.H. (Giner, Inc., Waltham, MA (USA)). Aug 1980. Contract AC04-79CS31072. 42p. NTIS, PC A03/MF A01.

The effects of glycol aging at elevated temperatures over long periods of time were studied and the zinc powder protective technique was optimized. Glycols are known to gradually decompose into organic acids at high temperatures. These product species may be aggressive to aluminum in the long run. In addition, corrosion inhibitors may also breakdown due to continuous exposure to high temperatures. As for the zinc powder protective technique, efforts have been made to determine the optimal conditions under which aluminum solar collector panels can be protected most effectively and economically. Both uninhibited and inhibited ethylene as well as propyleneglycols have been aged at three different temperatures (100, 140, and 190°C) for 6000 hours continuously. Aliquot samples were taken at 1000 hour intervals for pH measurement and chemical analysis. Results showed that in most cases solution pH dropped sharply during the first 1000 hours of exposure and gradually decreased at a slower pace as the aging process progressed. It was also noted that higher temperatures appeared to hasten this pH shift. The corrosiveness of these aged glycol solutions towards aluminum was determined based on laboratory corrosion tests. The critical pitting potential (E/sub p/) of aluminum in chloride-ion containing aqueous glycol solutions was determined. Its dependence on temperature, chloride-ion concentration, and glycol content was investigated in detail. E/sub p/ was found to become more negative with higher chloride-ion concentration, increasing temperature, and decreasing glycol content. (MHR)

34744 (DOE/ER/10575—1) **Fundamentals and techniques of nonimaging optics for solar energy concentration. Technical progress report.** Winston, R. (Chicago Univ., IL (USA). Enrico Fermi Inst.). 15 Sep 1980. Contract AC02-80ER10575. 50p. NTIS, PC A03/MF A01.

Recent progress in basic research into the theoretical understanding of nonimaging optical systems and their application to the design of practical solar concentrators is reviewed. Work has been done to extend the previously developed geometrical vector flux formalism with the goal of applying it to the analysis of non-ideal concentrators. Both phase space and vector flux representations for traditional concentrators have been generated. Our understanding of the thermodynamically derived relationship between concentration and cavity effects has led to the design of new lossless and low loss concentrators for absorbers with gaps. Quantitative measurements of the response of real collector systems and the distribution of diffuse insolation shows that in most cases performance exceeds predictions in solar applications. These developments have led and will continue to lead to improved nonimaging solar concentrator designs and applications.

34745 (DOE/R5/10143—1) **Low cost, bare plate solar air collector. Semi-annual progress report.** (ROM-AIRE Solar Corp., Avon Lake, OH (USA)). 1980. Contract FG02-79R510143. 15p. NTIS, PC A02/MF A01.

A low cost, bare plate solar collector that is specifically designed to preheat ambient air with solar energy is discussed. Two prototype solar collector test systems have been designed, fabricated and assembled. Each system has been instrumented to provide instantaneous and average thermal performance data by means of a computerized data logger system. This data logger system is currently being made operational. Data collection is scheduled to begin March 1, 1980 and continue until the project completion date of June 17, 1980. Some preliminary test data have been obtained for both prototype systems. The results showed that ambient air was preheated between 5°F and 10°F with the systems achieving a thermal performance of between 15% and 30% efficiency.

34746 (PNL—3194) **Heliostat mirror survey and analysis.** Lind, M.A.; Buckwalter, C.Q.; Daniel, J.L.; Hartman, J.S.; Thomas, M.T.; Pederson, L.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract AC06-76RL01830. 185p. NTIS, PC A09/MF A01.

The mirrors used on concentrating solar systems must be able to withstand severe and sustained environmental stresses for long periods of time if they are to be economically acceptable. Little is known about how commercially produced wet process silvered second surface mirrors will withstand the test of time in solar applications. Field experience in existing systems has shown that the performance of the reflective surface varies greatly with time and is influenced to a large extent by the construction details of the mirror module. Degradation of the reflective layer has been seen that ranges from non-observable to severe. The exact mechanisms involved in the degradation process are not well understood from either the phenomenological or microanalytical points of view and are thus subject to much debate. The three chapters of this report summarize the work recently performed in three general areas that are key to understanding and ultimately controlling the degradation phenomena. These areas are: a survey of the present commercial mirroring industry, the microanalytical examination of numerous degraded and nondegraded mirrors, and an investigation of several novel techniques that might be used to extend the life of heliostat mirrors. Appendices include: (a) list of mirror manufacturers and (b) recommended specifications for second surface silvered mirrors for central receiver heliostat applications. (WHK)

34747 (SAND—80-1480C) **Black chrome solar selective coating.** Pettit, R.B.; Sowell, R.R. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 24p. (CONF-800955—2). NTIS, PC A02/MF A01.

From Line-focus solar thermal energy technology development conference; Albuquerque, NM, USA (9 Sep 1980).

Electrodeposited black chrome solar selective coatings have frequently experienced thermal stability problems when heated to temperatures above 250°C (480°F) in air. By reducing the trivalent chromium concentration in the standard black chrome plating bath, coatings on nickel substrates are obtained which are stable for thousands of hours at 350°C (660°F) and for hundreds of hours at 400°C (750°F). These results have been obtained consistently on a laboratory scale, but difficulty in reproducing the results has been encountered in a production environment. A current study of the effects of known plating variables on the optical properties and thermal stability of coatings is aimed at establishing an acceptable range for each plating parameter. A preliminary process specification for electroplating mild steel substrates with a stable black chrome coating is presented.

34748 (SAND—80-1483C) **Development and testing of polymer reflectors.** Assink, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 9p. (CONF-800955—1). NTIS, PC A02/MF A01.

From Line-focus solar thermal energy technology development conference; Albuquerque, NM, USA (9 Sep 1980).

Metallized polymer sheets and films offer the potential of providing a low cost, light weight and easily installed solar reflector surface. Metallized polymers presently available, however, suffer from three disadvantages: (1) low initial reflectance; (2) uv degradation; and (3) surface abrasion. The solar reflectance properties of commercially available aluminized polymers are typically 0.06 to

0.10 reflectance units (1.00 reflectance units = 100 percent reflectance) lower than the solar reflectance properties of high quality silvered glasses. This difference results from the inherently lower solar reflectance of aluminium as compared to the solar reflectance of silver. Efforts to deposit and protect silver on a polymer surface have not been successful. uv degradation of polymers can affect the material's optical and mechanical properties. Recent studies, however, indicate that uv degradation may not be a serious problem for acrylic materials. Abrasion of the polymer surface by wind blown sand or contact cleaning methods can cause a substantial reduction in the specularity of the reflector. The purpose of this study is to develop and evaluate several abrasion resistant aluminized polymer reflectors suitable for solar applications. The lower initial reflectance of aluminized polymers may then be offset by the advantages previously mentioned. Results are reported.

34749 (SAND—80-1509C) **Development of a second generation portable specular reflectometer.** Freese, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 14p. (CONF-800955—4). NTIS, PC A02/MF A01.

From Line-focus solar thermal energy technology development conference; Albuquerque, NM, USA (9 Sep 1980).

The second generation design of a portable specular reflectometer developed by Sandia National Laboratories (SNL) has been completed together with a detailed drawing package. Two prototype instruments have been fabricated and evaluated. It has been demonstrated that the instruments respond linearly (+-0.006 transmission units) to variations in the intensity of incident and reflected beams and that the readings are not affected by the presence of stray light. As a result of this feature, the reflectometer is well suited for outdoor field use in a normal sunlight environment. A drift problem due to temperature was observed in the detector/preamp at temperatures > 100°F. This drift would probably be eliminated by redesign of the detector/preamp circuitry. A major improvement in the second generation reflectometer is the use of larger optics to allow averaging over a greater surface area (~ 1 cm^2) of a mirror. The new reflectometer has the capability of a straight-through beam configuration, allowing direct determination of the signal level corresponding to 100% reflectance. This capability also allows the user to measure the specular transmittance of materials. A microprocessor can be added to the output of the detector as an option to display percent reflectance values and mean and standard deviations of measurements made.

34750 (SAND—80-1541C) **Portable instrumentation for solar absorptance and emittance measurements.** Pettit, R.B.; Mahoney, A.R. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 34p. (CONF-800955—3). NTIS, PC A03/MF A01.

From Line-focus solar thermal energy technology development conference; Albuquerque, NM, USA (9 Sep 1980).

Two portable instruments, one designed for solar absorptance and the other for emittance measurements, have been evaluated. A Solar Spectrum Reflectometer was used for solar absorptance measurements while a model AE Emissometer was used to measure the emittance for an 80°C blackbody. Both instruments are manufactured by Devices and Services Co., Dallas, TX. The Solar Spectrum Reflectometer uses four different detector/filter combinations to match an air mass two solar spectral distribution. The solar absorptance values measured for a variety of solar coatings were determined to an accuracy of +-0.02 absorptance units. For second-surface solar mirrors, the instrument underestimates the hemispherical solar reflectance when the reflecting surface is more than 0.2 mm away from the measurement port. The emissometer consists of a heated measurement head and separate display unit. The accuracy of this instrument is better than +-0.03 emittance units for black chrome solar coatings and better than +-0.06 emittance units for all coatings studied.

34751 (TAC-STC—80-002) **Solar thermal components: a bibliography with abstracts. Quarterly update, April-June 1980.** Bozman, W.R. (ed.). (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jul 1980. 96p. Univ. of New Mexico, Technology Application Center, Albuquerque.

This annotated bibliography covers the following subjects: material properties, flat-plate collectors, concentrating collectors, heat pumps, coolers, heat exchangers, solar ponds, distillation, process heat, and irrigation pumps. An author index and a keyword index are included. (MHR)

34752 **Solar central receiver heliostat reflector assembly.** Horton, R.H.; Zdeb, J.J. (to Dept. of Energy). US Patent 4,209,236. 24 Jun 1980. Filed date 21 Oct 1977. 10p.

PAT-APPL-844,400.

A heliostat reflector assembly for a solar central receiver system comprises a light-weight, readily assemblable frame which supports a sheet of stretchable reflective material and includes mechanism for selectively applying tension to and positioning the sheet to stretch it to optical flatness. The frame is mounted on and supported by a pipe pedestal assembly that, in turn, is installed in the ground. The frame is controllably driven in a predetermined way by a light-weight drive system so as to be angularly adjustable in both elevation and azimuth to track the sun and efficiently continuously reflect the sun's rays to a focal zone, i.e., central receiver, which forms part of a solar energy utilization system, such as a solar energy fueled electrical power generation system. The frame may include a built-in system for testing for optical flatness of the reflector. The preferable geometric configuration of the reflector is octagonal; however, it may be other shapes, such as hexagonal, pentagonal or square. Several different embodiments of means for tensioning and positioning the reflector to achieve optical flatness are disclosed. The reflector assembly is based on the stretch frame concept which provides an extremely light-weight, simple, low-cost reflector assembly that may be driven for positioning and tracking by a light-weight, inexpensive drive system. 14 claims.

34753 **Annealed CVD molybdenum thin film surface.** Carver, G.E.; Seraphin, B.O. US Patent Application 105,338. 19 Dec 1979. 22p.

Molybdenum thin films deposited by pyrolytic decomposition of $Mo(CO)_6$ attain, after anneal in a reducing atmosphere at temperatures greater than 700°C, infrared reflectance values greater than reflectance of supersmooth bulk molybdenum. Black molybdenum films deposited under oxidizing conditions and annealed, when covered with an anti-reflecting coating, approach the ideal solar collector characteristic of visible light absorber and infrared energy reflector.

34754 **Mirror enclosures for double-exposure solar collectors.** Larson, D.C. (Drexel Univ, Philadelphia, Pa). *Sol. Energy;* **23**: No. 6, 517-524(1979).

Several flat-mirror collector panel configurations are evaluated and optimal configurations are determined for different solar energy applications at lat. 35, 40 and 45°. The various mirror configurations are evaluated theoretically by calculating direct-beam and diffuse solar radiation enhancement factors. The enhancement factors are defined as the ratio of the solar flux absorbed by both sides of a double-exposure panel to that absorbed by an identical single-exposure panel tilted at the latitude angle from the horizontal. The enhancement factors are calculated using the method of images and take account of the variation of glazing transmittance with incident angle. Optimal mirror configurations were determined for direct-beam solar radiation for both fixed-mirror configurations and adjustable-mirror configurations with semi-annual mirror rotations. Optimal fixed-mirror configurations were obtained for both winter space-heating and year-round applications. 19 refs.

34755 **Optimal controllers of the second kind.** Winn, C.B.; Hull, D.E. III. (Colo State Univ, Fort Collins). *Sol. Energy;* **23**: No. 6, 529-534(1979).

An approximate analytical solution to the problem of determining the optimal flow rate through solar collectors so as to minimize the integral of the difference between the useful energy and the pumping costs incurred in collecting the solar energy has been obtained. The solution that is presented is an optimal feedback controller that is based upon measurable states of the system. The solution technique that was employed was that of the L.S. Pontryagin maximum principle and an approximate analytical solution to the resulting two-point boundary value problem was obtained by means of a transformation that involved using the heat removal factor as the control. 5 refs.

HEAT STORAGE

34756 (COO—4583-1) **Solar-thermal energy conversion and storage: cyclohexane dehydrogenation. Progress report, 30 September 1977-30 June 1978.** Ritter, A.B.; DeLancey, G.B.; Schneider, J.; Silla, H. (Stevens Inst. of Tech., Hoboken, NJ (USA)). Jul 1978. Contract AS02-77ET26956. 32p. NTIS, PC A03/MF A01.

The objective of this project is to provide research support for the benzene/cyclohexane heat pipe development program at Sandia. The kinetics of the cyclohexane decomposition (energy collection) reaction over a commercially available naphtha reforming catalyst (RD-150, Englehard Industries) in the temperature range 400 to 800°F and pressures of 1 to 40 atmospheres were measured. Significant amounts of side products such as toluene and butane were identified at temperatures above 550°F at atmospheric pressure and significant mass transfer limitations on conversions were observed at the higher space velocities and higher temperatures. No significant decreases in catalyst activity were measured at temperatures below 800°F. However, at 800°F there was a significant decrease in catalyst activity which does not appear to be a poisoning problem but a thermal limitation on catalyst effectiveness. A test facility has been fabricated to study the behavior of the benzene/cyclohexane (or any other gas phase catalytic reaction) system and its catalysts under long term cycling at temperatures up to 1000°F,

and pressures up to 1000 psig at a wide variety of space velocities. A mathematical model was developed which simulates the dynamic behavior of the collector (endothermic) reactor and allows the evaluation of such things as startup, shutdown, switching and process control algorithms.

34757 (PB—80-116890) **A solar heated asphalt storage tank. Technology sharing report (final).** (Oklahoma Dept. of Transportation, Oklahoma City (USA). Research and Development Div.). Aug 1978. 69p. NTIS, PC A04/MF A01.

The report discusses the design, layout, installation, and testing of a 10,000 gallon solar heated asphalt storage tank. Schematic diagrams, plans, piping, solar panels, controls, specifications, and one year's performance data for the system are also given. The concepts and data presented will be of an aid to others who plan to design their own system. Oklahoma Department of Transportation reports that the total ($4,829.00) cost of an insulated solar heated asphalt storage tank system is expected to be recovered in less than two years through reduced operating expenses. The cost advantages and uninterrupted heating capability are documented by a cost and operation analysis between the insulated solar tank and an adjacent uninsulated propane heated tank. The solar heating system is straight-forward, simple, inexpensive, and dependable. It can be used throughout the year in a wide geographical area and the use of solar power can reduce our nation's fossil energy consumption and highway maintenance costs.

34758 (SERI/PR—631-636) **Solar energy storage program: FY79 annual report.** Wyman, C.E.; Copeland, R.J.; Wright, J.D.; Baylin, F. (Solar Energy Research Inst., Golden, CO (USA)). May 1980. Contract AC02-77CH00178. 12p. NTIS, PC A02/MF A01.

This report summarizes the SERI Solar Energy Storage Program, which made a strong start in FY79. In support of the joint DOE Thermal Energy Storage for Solar Thermal plan, a ranking methodology was developed in the Thermal Storage Requirements Task for selection of thermal energy storage technologies for solar thermal applications. The ranking is based on cost and performance data, and a request for proposals was written in FY79 to be used in competitive selection of a subcontractor to generate this data. Also, thermal storage value data based on costs of alternative energy systems were generated for electric power plants and will be used for cost goals as a preliminary thermal storage screening tool. In the future, this task will provide support to key decision points in the joint multiyear program plan. In the Thermal Storage Development Task, a survey was completed of thermal energy storage technologies, projects, and economics. An analysis was then made of latent heat storage for solar heating based on previous system simulations. The only major advantage shown for latent heat storage is a reduced storage volume and not the improved solar system performance frequently postulated. Therefore, latent heat storage must be competitively priced with sensuible heat options. Direct contact latent heat storage offers satisfactory low-cost potential and has additional merit in that the concept could be used for a wide range of temperatures.

34759 (SERI/RR—721-455) **Central unresolved issues in thermal energy storage for building heating and cooling.** Swet, C.J.; Baylin, F. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 48p. NTIS, PC A03/MF A01.

This document explores the frontier of the rapidly expanding field of thermal energy storage, investigates unresolved issues, outlines research aimed at finding solutions, and suggests avenues meriting future research. Issues related to applications include value-based ranking of storage concepts, temperature constraints, consistency of assumptions, nomenclature and taxonomy, and screening criteria for materials. Issues related to technologies include assessing seasonal storage concepts, diurnal coolness storage, selection of hot-side storage concepts for cooling-only systems, phase-change storage in building materials, freeze protection for solar water heating systems, and justification of phase-change storage for active solar space heating.

34760 (SERI/RR—721-676) **Systems analysis techniques for annual cycle thermal energy storage solar systems.** Baylin, F.; Sillman, S. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 34p. NTIS, PC A03/MF A01.

Community-scale annual cycle thermal energy storage (ACTES) solar systems are promising options for building heat and cooling. A variety of approaches are feasible in modeling ACTES solar systems. The key parameter in such efforts, average collector efficiency, is first examined, followed by several approaches for simple and effective modeling. Methods are also examined for modeling building loads for structures based on both conventional and passive architectural designs. Two simulation models for sizing solar heating systems with annual storage are presented next. Validation is presented by comparison with the results of a study of seasonal storage systems based on SOLANSIM, an hour-by-hour simulation. These models are presently being used to examine the economic trade-off between collector field area and storage capacity. Finally, programs in the US Department of Energy directed toward developing either other system components such as improved tanks and solar ponds or design tools for ACTES solar systems are examined.

34761 (SERI/TP—631-841) **Systems analysis of thermal storage.** Copeland, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1980. Contract AC02-77CH00178. 6p. (CONF-801055—1). NTIS, PC A02/MF A01.

From 5. annual thermal storage meeting; McLean, VA, USA (10 Oct 1980).

During FY80 analyses were conducted on thermal storage concepts for solar thermal applications. These studies include both estimates of the obtainable costs of thermal storage concepts and their worth to a user (i.e., value). Based on obtainable costs and performance, promising thermal storage concepts are being identified. A preliminary screening was completed in FY80 and a more in-depth study was initiated. Value studies are being conducted to establish cost goals. A ranking of storage concepts based on value in solar thermal electric plants was conducted for both diurnal and long duration applications. Ground mounted thermal storage concepts for a parabolic dish/Stirling systtem are also being evaluated.

34762 (SERI/TR—721-575) **Annual-cycle thermal energy storage for a community solar system: details of a sensitivity analysis.** Baylin, F.; Monte, R.; Sillman, S. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 88p. NTIS, PC A05/MF A01.

This report presents results and conclusions of a simulation and sensitivity analysis of community-sized, annual-cycle thermal-energy-storage (ACTES) solar energy systems. The analysis which is based on an hourly simulation is used to (1) size systems in 10 locations, (2) identify critical design parameters, and (3) provide a basic conceptual approach for future studies and designs. This research is a forerunner to an economic analysis of this particular system (based on large constructed tanks) and a general analysis of the value of ACTES technologies for solar applications. A total of 440 systems were sized for 10 locations in the United States. Three different building types and four different community sizes were modeled. All designs used each of two collector types at each of two different tilt angles. Two linear relationships were derived which simplify system sizing. The average ambient temperature is used to determine average yearly collector efficiency. This parameter combined with estimates of space/DHW loads, storage/distribution losses, and total yearly insolation per square meter allows estimation of collector area. Storage size can be estimated from the winter net load which is based on space and DHW loads, storage and distribution losses, and collector solar heat gain for the winter months.

34763 **Thermal energy storage in a packed bed of iron spheres with liquid sodium coolant.** Pomeroy, B.D. (GE, Schenectady, NY). *Sol. Energy;* **23**: No. 6, 513-515(1979).

The major design parameters for sodium-iron packed-bed thermal storage have been identified, and a simple deign procedure has been developed based on several independent mathematical models for the transient heat transfer effects. These relations show that it is possible to select the sodium-iron storage design parameters so as to limit thermocline spreading to less than 20 per cent of the total discharge time. 7 refs.

GEOTHERMAL ENERGY

34764 (DOE/RA—0051/4) **Geothermal progress monitor. Progress report No. 4.** (Mitre Corp., McLean, VA (USA); Interagency Geothermal Coordinating Council, Washington, DC (USA)). Sep 1980. Contract AC01-79ET27224. 109p. NTIS, PC A06/MF A01.

The following are included: geothermal power plants proposed and on-line; direct heat applications proposed and operational; trends in drilling activities; exploration; leases; outreach and technical assistance; feasibility studies and application demonstrations; geothermal loan guaranty program; research and development activities; legal, institutional, and regulatory activities; environmental activities; reports and publications; and a directory. (MHR)

34765 (LBL—10686) **Earth Sciences Division. Annual report 1979.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 239p. NTIS, PC A11/MF A01.

This annual report contains articles describing the research programs conducted during the year. Major areas of interest include geothermal exploration technology, geothermal energy conversion technology, reservoir engineering, geothermal environmental research, basic geosciences studies, applied geosciences studies, nuclear waste isolation, and marine sciences. (ACR)

RESOURCE STATUS AND ASSESSMENT

34766 Methods for regional assessment of geothermal resources. Muffler, P.; Cataldi, R. (US Geol Surv, Menlo Park, Calif). *Geothermics;* 7: No. 2-4, 53-89(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

This report deals wit the subject of geothermal assessment methodology, providing a comprehensive evaluation of various assessment techniques. It also proposes geothermal resource terminology that is compatible with established usage in the mining and petroleum industries and, moreover, takes into account the particular characteristics of geothermal energy. Also proposed is a methodology for forthcoming refinements and revisions of geothermal resource assessment in the US and Italy. 60 refs.

34767 United Nations' approach to geothermal resource assessment. McNitt, J.R. (UN, New York, NY). *Geothermics;* 7: No. 2-4, 231-242(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

Although the emphasis of United Nations' assisted geothermal projects has been on demonstrating the feasibility of producing geothermal fluids, the potential capacity of individual fields has been estimated by both the energy in place and decline curve methods. A new method for making regional assessment of geothermal potential is described, which is based, in part, on an assessment of the probable range of the power potential of geothemal fields as inferred from a frequency distribution analysis of fields already under development throughout the world. Depending on the reservoir containing dry steam or water, and its location in a region of groundwater recharge or discharge, average power potentials can be expected to range from 36 to 3360 MW. Refs.

34768 Proceedings of the ENEL-ERDA workshop on geothermal resource assessment and reservoir engineering, 1977. Barbier, E. (ed.). (Natl Res Counc, Int Inst for Geotherm Res, Pisa, Italy). *Geothermics;* 7: No. 2-4, vp(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

This issue contains five papers presented at this Larderello, Italy, Workshop. Indexed separately, these papers cover the results of the following five tasks within the workshop's Project 3: Methods for regional assessment of geothermal resources; Assessment of geothermal potential of central and southerm Tuscany; Analysis of reservoir pressure and decline curves in Serazzano zone (Larderello geothermal field); Welt-testing in Travale-Radicondoli geothermal field; Thermodynamic study of the Bagnore geothermal field. The issue also presents four invited papers and one informal communication on related subjects.

USA

REFER ALSO TO CITATION(S) 34797, 34847

34769 (CONF-800920—28) **Preliminary direct heat geothermal resource assessment of the Tennessee Valley region.** Staub, W.P. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). 1980. Contract AC05-76OR00033. 5p. NTIS, PC A02/MF A01.

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

A preliminary appraisal of the direct heat geothermal energy resources of the Tennessee Valley region has been completed. This region includes Kentucky, Tennessee and parts of adjacent states. Intermediate and deep aquifers were selected for study. Basement and Top-of-Knox structure and temperature maps were compiled from oil and gas well data on file at various state geological survey offices. Results of this study indicate that the New Madrid seismic zone is the only area within the region that possesses potential for direct heat utilization. In other areas geothermal energy is either too deep for economical extraction or it will not be able to compete with other local energy resources. The only anomalously high temperature well outside the New Madrid seismic zone was located in the Rome Trough and near the central part of the eastern Kentucky coal basin. Geothermal energy in that region would face strong competition from coal, oil and natural gas.

34770 (DOE/ET/28505—T2) **Conceptual design of a geothermal site development forecasting system.** Neham, E.A.; Entingh, D.J. (Mitre Corp., McLean, VA (USA). METREK Div.). Mar 1980. Contract AC01-77ET28505. 49p. (MTR—80W72). NTIS, PC A03/MF A01.

A site development forecasting system has been designed in response to the need to monitor and forecast the development of specific geothermal resource sites for electrical power generation and direct heat applications. The system is comprised of customized software, a site development status data base, and a set of complex geothermal project development schedules. The system would use site-specific development status information obtained from the Geothermal Progress Monitor and other data derived from economic and market penetration studies to produce reports on the rates of geothermal energy development, federal agency manpower requirements to ensure these developments, and capital expenditures and technical/laborer manpower required to achieve these developments.

34771 Evaluation of Baltazor Known Geothermal Resources Area, Nevada. Isherwood, W.F.; Mabey, D.R. (US Geol Surv, Menlo Park, Calif). *Geothermics;* 7: No. 2-4, 221-229(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

By virtue of the Geothermal Steam Act of 1970, the US Geological Survey is required to appraise geothermal resources of the United States prior to competitive lease sales. This appraisal involves coordinated input from a variety of disciplines, starting with reconnaissance geology and geophysics. This paper describes how the results of several geophysical methods used in KGRA (Known Geothermal Resources Areas) evaluation were interpreted by the authors, two geophysicists, involved with both the Evluation Committee and the research program responsible for obtaining and interpreting the geophysical data to be used by the committee. 9 refs.

34772 Reservoir performance of The Geysers field. Lipman, S.C.; Strobel, C.J.; Gulati, M.S. (Union Oil Co of Calif, Santa Rosa). *Geothermics;* 7: No. 2-4, 209-219(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

The Geysers Field, located in Northern California, has an installed generating capacity of 502 MWe. Total withdrawal rate is approximately 8.5 million lb/h of steam from 95 wells. Four new generating plants are currently under construction, which will bring the installed capacity to 908 MWe by 1979. The initial development at The Geysers Field occurred in an area which has two shallow dry steam anomalies. Recent studies have shown that the steam in these anomalies is being fed through fractures connecting them with the deeper regional fracture system. Based on the successful exploratory wells drilled to date, it is estimated that the generating capacity of The Geysers could reach 1800 MW by the mid-1980s.

NON-USA

34773 Assessment of geothermal potential of central and southern Tuscany. Cataldi, R.; Lazzarotto, A.; Muffler, P.; Squarci, P.; Stefani, G. (Ente Naz per l'Energy Elettr, Pisa, Italy). *Geothermics;* 7: No. 2-4, 91-131(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

Central and southern Tuscany contain all the presently exploited geothermal fields of Italy, and accordingly were chosen to test the geothermal resource assessment methodology described by Muffler and Cataldi. Using new compilations at 1:200,000 of all available drill-hole, geological, gravity, and thermal-gradient data, the region was divided into 31 zones, each of reasonably homogenous geology and thermal regime. The upper 3 km of each area was then divided by horizontal surfaces into three volumes. The aggregate of the values obtained was designated as the "accessible geothermal resource base" of central and southerm Tuscany. 13 refs.

34774 Analysis of reservoir pressure and decline curves in Serrazzano Zone, Larderello geothermal field. Atkinson, P.; Miller, F.G.; Marconcini, R.; Neri, G.; Celati, R. (Stanford Univ, Calif). *Geothermics;* 7: No. 2-4, 133-144(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

An estimate of reserves in the Serrazzano reservoir was obtained from mass balance studies and production decline curve analyses. The Serrazzano reservoir consists of a geometrically well-defined structural high of permeable formations separated from the other productive regions of the Larderello field. An empirical type-curve matching technique was applied to the production decline curves of wells in the reservoir. The curve for each well was extrapolated to infinite production time to obtain an estimate of total past and future production. Summing these values for all producing wells in the reservoir, an estimated total production (past and future) of 200 x 10^6 tons was obtained. 9 refs.

34775 Well-testing in Travale-Radicondoli field. Atkinson, P.; Barelli, A.; Brigham, W.; Celati, R.; Manetti, G.; Miller, F.G.; Neri, G.; Ramey, H.J. Jr. (Stanford Univ, Calif). *Geothermics;* 7: No. 2-4, 145-184(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

The theory and applications of pressure transient (well test) analysis have been studied intensively for more than 40 yr by petroleum reservoir engineers and groundwater hydrologists. Only

in the past decade, however, have geothermal-fluid wells been tested for the purpose of making pressure transient studies. Results of these studies disclose various well conditions, for example, restrictions to fluid flow into the wellbore. They also disclose reservoir heterogeneities, boundaries and permeability-thickness products of reservoir rocks. Probably most important, they can be used in estimations of energy reserves. This powerful analytical tool is discussed with special reference to the Travale reservoir in Italy. The article is presented in five parts. Refs.

34776 Estimate of the resource potential of New Zealand geothermal fields for power generation. Donaldson, I.G.; Grant, M.A. (Phys and Eng Lab, Lower Hutt, NZ). *Geothermics;* 7: No. 2-4, 243-252(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

The basic similarity between most of the New Zealand geothermal fields suggests that the exploited fields of Wairakei an Broalands can be used as indicators of the potential of other fields as resources for steam for power production. Assuming adequate permeability will be obtained in fields yet to be tested, the two parameters controlling this potential are areal extent (as defined by resistivity survey) and temperature at depth. Based upon their present knowledge of the fields in question the authors assess the fields' proven, inferred and speculative reserves. The totals for all fields of 450 MWe proven, 750 MWe inferred and 1300 MWe speculative suggest that New Zealand has come 1300-2500 MWe available from its geothermal resources should it desire to exploit these for electrical power.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

REFER ALSO TO CITATION(S) 34824

34777 (SGP-TR—40, pp 173-182) **Semi-analytical description of two-phase flow near production wells in hydrothermal and geopressured reservoirs.** Pritchett, J.W. (Systems, Science and Software, La Jolla, CA). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Certain constitutive approximations are introduced in analytical form for both cases of interest (water/steam and water/gas). It is demonstrated that these approximations, when combined with the basic conservation laws, yield a much simpler set of equations in each case consisting of a single algebraic equation, a single ordinary integral, and the prescribed relative permeability data. It is further shown that the resulting equations are of the same form for both cases (water/steam and water/gas) so that they may be solved by the same procedures. Although numerical methods are still needed to solve the integral, an enormous simplification compared to the general case has been achieved. Finally, comparisons between results for the present simplified scheme and results generated by numerical integration of the basic equations show that the simplified scheme, in spite of the relatively crude constitutive assumption employed, is entirely adequate for engineering purposes. To develop the simplified theory, steady horizontal fluid flow is considered first which is one-dimensional in the sense that all physical variables are to be determined as functions of a single scalar space variable x. Flow rates are generally high near wells, so the effects of both heat conduction and capillarity are neglected. The fluid consists of a mixture of H_2O and one additional chemical species. (MHR)

34778 (SGP-TR—40, pp 183-188) **Geothermal reservoir simulations with SHAFT79.** Pruess, K.; Schroeder, R.C. (Lawrence Berkeley Lab., CA). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The simulator SHAFT79 was developed for computing two-phase flow phenomena in geothermal reservoirs. The program handles transient initial-value problems with prescribed boundary conditions. SHAFT79 is an improved version of the simulator SHAFT78. It solves coupled equations for mass- and energy-transport, using an integrated finite difference method. This method allows a very flexible description of reservoirs because it does not distinguish between one-, two-, or three-dimensional regular or irregular geometries. (MHR)

34779 (SGP-TR—40, pp 241-256) **Best uses of numerical simulators.** Donaldson, I.G.; Sorey, M.L. (Department of Scientific and Industrial Research, Lower Hutt, New Zealand). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The real value and best uses of geothermal reservoir simulations are discussed. The distribution-parameter modeling approach is described. Reasons for the failure of simulations to match observed data are given. (MHR)

34780 (SGP-TR—40, pp 283-297) **Models for steam chemistry at Larderello and The Geysers.** D'Amore, F. (International Inst. for Geothermal Research, Pisa, Italy); Truesdell, A.H. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Evolution with time of the chemistry of steam from three typical Larderello wells is interpreted to indicate that three sources contribute progressively to steam production. Chemical and isotopic compositional variations with geographic location are interpreted as resulting from pre-exploitation lateral steam flow from central boiling (or inflow) zones toward the edges of the system. During this lateral flow, conductive heat loss to the surface results in partial condensation; gases are concentrated in the residual steam and slightly volatile salts are removed into the condensate. This process is modeled as a Raleigh condensation obeying the equation: C/C/sub o/ = (m/m/sub o/)/sup (1/K-1)/ where at any point C/Co/sub o/ is the ratio of the concentration of a steam component to its original concentration; m/m/sub o/ is the fraction of steam condensed; and K is the distribution coefficient of the component between steam and water (C/sub s//C/sub w/). The magnitudes of the variations at Larderello (-3‰ in $\delta^{18}O$, +5x in CO_2 and +3x in NH_3) suggest that the productive field is limited by excessive liquid water and noncondensable gas when 80% of the original steam flow has condensed. At The Geysers, a 17x increase in CO_2 and a 7‰ decrease in $\delta^{18}O$ suggest that the limit is at 95% condensation. Lateral steam movement and condensation may have created the large lateral extent and cavernous porosity of these systems by leaching the reservoir rock. This model may be used with steam analyses from existing wells to guide field development.

34781 (SGP-TR—40, pp 359-366) **Elastomechanical phenomena and the fluid conductivity of deep geothermal reservoirs and source regions.** Bodvarsson, G. (Oregon State Univ., OR). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

A few elastomechanical aspects of fracture formation are discussed and some relevant field observations are listed. In particular, interest is focused on the role of thermal convective flows of fluids in fractures that because of local thermoelastic contraction in the adjacent rock contribute to the extension or formation of new fractures. This process is referred to as convective downward migration of fractures. (MHR)

34782 Transient-pressure analysis in geothermal steam reservoirs with an immobile vaporizing liquid phase. Moench, A.F.; Atkinson, P.G. (US Geol Surv, Menlo Park, Calif). *Geothermics;* 7: No. 2-4, 253-264(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

A finite-difference model for the radial horizontal flow of steam through a porous medium is used to evaluate transient-pressure behavior in the presence of an immobile vaporizing or condensing liquid phase. Graphs of pressure drawdown and buildup in terms of dimensionless pressure and time are obtained for a well discharging steam at a constant mass flow rate for a specified time. Computations show that when a vaporizing liquid phase is present the pressure drawdown exhibits behavior similar to that observed in noncondensable gas reservoirs, but delayed in time. A theoretical analysis allows for the computation of this delay and demonstrates that it is independent of flow geometry.

USA

REFER ALSO TO CITATION(S) 34790, 34835

34783 (DOE/ID/12079—12) **Chemical trends in the Ice Springs basalt, Black Rock Desert, Utah.** Lynch, W.C.; Nash, W.P. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Jun 1980. Contract AC07-79ID12079. 96p. NTIS, PC A05/MF A01.

The Holocene Ice Springs volcanic field of west-central Utah consists of 0.53 km^3 of tholeiitic basalts erupted as a sequence of nested cinder cones and associated lava flows. Whole rock x-ray fluorescence and atomic absorption analysis of ninety-six samples of known relative age document statistically significant inter- and intra-eruption chemical variations. Elemental trends include increases in Ti, Fe, Ca, P, and Sr and decreases in Si, K, Rb, Ni, Cr, and Zr with decreasing age. Microprobe analyses of microphenocrysts of olivine, plagioclase, and Fe-Ti oxides and of groundmass olivine, plagioclase, and clinopyroxene indicate limited chemical variation between mineral assemblages of the eruptive events. Petrographic analyses have identified the presence of minor amounts of silicic xenoliths, orthopyroxene megacrysts, and plagioclase xenocrysts. Potassium-argon determinations establish the existence of excess argon in the basaltic cinder (30.05×10^{-12} moles/gm) and in distal lava flows (8.29×10^{-12} moles/gm) which suggest apparent ages of 16 and 4.3 million years

respectively. Strontium isotopic data (Puskar and Condie, 1973) show systematic variations from oldest eruptions ($^{87}Sr/^{86}Sr = 0.7052$) to youngest eruptions ($^{87}Sr/^{86}Sr = 0.7059$).

34784 (SGP-TR—40, pp 131-137) **Tidal pressure response well testing at the Salton Sea Geothermal Field, California, and Raft River, Idaho.** Hanson, J.M. (Univ. of California, Livermore). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The tidal pressure response was analyzed at two wells, Elmore 3 and Sinclair 3, at the Salton Sea Geothermal Field (SSGF) in California. Considerable geophysical and geological information in addition to conventional well testing results is available for this area. It is hoped to use these data to more rigorously test existing tidal response models. Some preliminary results of the estimation of the effective compressibility of the reservoir rock at Elmore 3 are presented. In addition, the possibility of using tidal pressure response to better understand the nature of the geothermal resource at Raft River, Idaho, is under investigation. This system is structurally complex, and existing models for tidal response of homogeneous and isotropic aquifers are not applicable. Work is currently in progress on defining an appropriate model for this system. Records were analyzed from six wells at Raft River: RRGE-1, RRGE-2, RRGE-3, RRGE-4, RRGI-6, and RRGI-7. The tidal admittance has been calculated for these wells and the results are presented.

34785 (SGP-TR—40, pp 211-214) **Preliminary model of the East Mesa hydrothermal system.** Riney, T.D.; Pritchett, J.W.; Rice, L.F.; Garg, S.K. (Systems, Science and Software, La Jolla, CA). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

A preliminary conceptual model of the East Mesa hydrothermal system is developed and a subregion selected for quantitative modeling. An axisymmetric model approximating the data available within the subregion is used together with a reservoir simulator to develop a computer model simulating the natural flow of heat and fluid mass within this geometric constraint. The axisymmetric calculations demonstrate that the balance between the convective and conductive modes of heat transport required to match the temperature and heat flow data implies a very low effective formation vertical permeability throughout the system.

NON-USA

34786 (SGP-TR—40, pp 215-227) **Validation and comparison of different models of the Wairakei geothermal reservoir.** Sorey, M.L. (Geological Survey, Menlo Park, CA); Ju Fradkin, L. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The zero-dimensional, or lumped parameter models of the Wairakei reservoir are presented and system identification techniques are used to find the best analytical expression for the average pressure response. It is shown that the corresponding conceptual model may be interpreted as a slow-drainage model in which portions of the reservoir where two-phase conditions develop serve mainly as a source of liquid for the underlying single-phase region from which most of the production is obtained. (MHR)

34787 (SGP-TR—40, pp 269-274) **Preliminary study of the Chingshui geothermal area.** Chiang, S.C.; Lin, J.J.; Chang, C.R.Y.; Wu, T.M. (Chinese Petroleum Corp., Taiwan). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The Chingshui geothermal area is located about 20 km southwest of Ilan, a city in northeastern Taiwan. This area was first selected for reconnaissance survey of geothermal resources in 1973 by means of geological and geophysical methods. A total of fifteen shallow test wells, ranging from 161 m to 501 m, were also drilled, penetrating aquifers with rather high temperatures of up to 175°C. However, further exploration has been subsequently undertaken by the Chinese Petroleum Corporation from 1976 to explore for a usable geothermal resource with greater production for power generation. Up to now, over eight geothermal wells, CPC-CS-4T, 5T, 9T, 12T, 13T, 14T, 15T, and 16T, have been drilled to various depths, ranging from 1505 m to 3000 m, having a roughly estimated thermal water flowrate of about 370 tons/h under the flowing pressure of about 8 kg/cm² on the gauge. Before or during the drilling, several geological, geophysical, and geochemical methods have been conducted by CPC. A reliable geologic feature was realized by geological and gravity data, while a geothermal activity was revealed by microearthquakes, resistivity, temperature gradients, and concentrated mercury data.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 34787

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 34769

34788 (DOE/ID/12079—14) **Gravity survey of the Escalante Desert and vicinity, in Iron and Washington Counties, Utah.** Pe, W.; Cook, K.L. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Aug 1980. Contract AC07-79ID12079. 169p. NTIS, PC A08/MF A01.

Thesis.

During the summers of 1978 and 1979, a total of 436 new gravity stations were taken in the southern part of the Escalante Desert and vicinity in Iron and Washington counties, Utah. The new stations were combined with 917 other stations taken in previous surveys, and a total of 1353 stations were used in this study, covering an area of about 2700 mi² (7000 km²). The purpose of the study was to help evaluate the potential of geothermal resources within the survey area, which includes the Newcastle and Lund KGRA's. All the gravity data were terrain corrected out to a radial distance of 166.7 km from each station, using a computer terrain-correction program. The data were compiled and presented as a complete Bouguer gravity anomaly map with a 2-mgal contour interval. A geologic interpretation of the gravity data was made qualitatively from the gravity map and also quantitatively from four easterly trending gravity profiles taken across the area.

34789 (LBL—10993) **Electromagnetic (EM-60) survey in the Panther Canyon Area, Grass Valley, Nevada.** Wilt, M.; Goldstein, N.; Stark, M.; Haught, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1980. Contract W-7405-ENG-48. 98p. NTIS, PC A05/MF A01.

Eight frequency domain electromagnetic soundings were measured over the Panther Canyon thermal anomaly in Grass Valley, Nevada. The data were collected with Lawrence Berkeley Laboratory's large moment horizontal loop system (EM-60). At the transmitter site located near the center of the thermal anomaly, square wave currents of up to 70 A were impressed into a fourturn 50 m radius coil at frequencies from 0.033 to 500 Hz. At the eight receiver sites, 0.5 to 1.5 km from the loop, magnetic fields were detected with a three-component SQUID magnetometer and vertical and radial magnetic field spectra were calculated. Data were interpreted with a computer program which fit filled spectra and associated ellipse polarization data to one-dimensional resistivity models and results were compared to interpretations from earlier dipole-dipole resistivity measurements. Comparison of these interpretations indicates fairly close agreement between the two, with both models clearly indicating the presence and dimensions of the conductivity anomaly associated with the thermal zone. Although the dc data was better able to resolve the high resistivity bedrock, the EM-data were able to resolve all major features without distortion at shorter transmitter receiver separations and in about one-third of the field time.

GEOCHEMICAL TECHNIQUES AND SURVEYS

34790 (DOE/ET/27002—7) **Multielement geochemistry of solid materials in geothermal systems and its applications. Part 1. Hot-water system at the Roosevelt Hot Springs KGRA, Utah.** Bamford, R.W.; Christensen, O.D.; Capuano, R.M. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Feb 1980. Contract AC03-79ET27002. 178p. NTIS, PC A09/MF A01.

Geochemical studies of the geothermal system at Roosevelt Hot Springs, Utah, have led to development of chemical criteria for recognition of major features of the system and to a three-dimensional model for chemical zoning in the system. Based on this improved level of understanding several new or modified geochemical exploration and assessment techniques have been defined and are probably broadly applicable to evaluation of hot-water geothermal systems. The main purpose of this work was the development or adaptation of solids geochemical exploration techniques for use in the geothermal environment. (MHR)

34791 (DOE/ID/12079—2) **Multielement analysis of geologic materials by inductively coupled plasma-atomic emission spectroscopy.** Christensen, O.D.; Kroneman, R.L.; Capuano, R.M. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Mar 1980. Contract AC07-79ID12079. 38p. NTIS, PC A03/MF A01.

Atomic emission spectroscopy using an inductively coupled plasma (ICP) source permits the rapid acquisition of multielement geochemical data from a wide variety of geologic materials. Rocks or other solid samples are taken into solution with a four acid digestion procedure and introduced directly into the plasma; fluid samples are acidified or analyzed directly. The entire process is computer-controlled, fully-automated, and requires less than five minutes per sample for quantitative determination of 37 elements. The procedures and instrumentation employed at the ESL for multielement ICP analysis of geologic materials are described and these are intended as a guide for evaluating analytic results reported from

this laboratory. The quality of geochemical data can be characterized by precision, limits of quantitative determination, and accuracy. Precision values are a measure of the repeatability of analyses. In general, major element and analyses have precision of better than 5% and trace elements of better than 10% of the amount present. (MHR)

34792 (SGP-TR—40, pp 327-333) **Radon transect and emanation studies.** Kruger, P.; Macias-C. L.; Semprini, L. (Stanford Univ., CA). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Current efforts were focused on two types of experiments to amplify the radon transient technique: (1) radon transect analysis to examine the distribution of steam age in relation to the 3.83-day half life of radon; and (2) radon emanating power to relate concentration to the properties of the reservoir and geofluid. The experiments and some results are described. (MHR)

34793 (SGP-TR—40, pp 335-341) **Radon-222 measurements at Wairakei, Broadlands and Ngawha.** Whitehead, N.E. (Department of Scientific and Industrial Research, Lower Hutt, New Zealand). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The method used for estimation of radon was designed for measuring radon in water, and is modified here to measure radon in steam. At Wairakei, the bores selected were known to emit widely varying chemical compositions. At Broadlands, as many bores as were open were sampled. In addition, analyses were performed on the water of the Waikato River. The material emerging from the bores at Wairakei and Broadlands is a mixture of steam and water, and the water is separated from the steam in a cyclone separator. This water currently flows to waste, and might contain and release radon to the air. It was therefore analyzed. At Ngawha, samples were not collected from the bores which were very few in number, but from the hot springs only. A final sample type was the stack gases at Wairakei. The separated gases from the condensed steam in the power station are mixed with air (about 1:2) and allowed to escape to the atmosphere through four stacks.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 34819

34794 (LA—8253-MS) **Compilation of cores and cuttings from U.S. Government-sponsored geothermal wells.** Mathews, M.; Gambill, D.T.; Rowley, J.C. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 150p. NTIS, PC A07/MF A01.

This compendium lists the repositories holding geothermal core and well cuttings from US government-sponsored geothermal wells. Also, a partial listing of cores and cutting from these wells is tabulated, along with referenced reports and location maps. These samples are available to the public for research investigations and studies, usually following submission of an appropriate request for use of the samples. The purpose of this compilation is to serve as a possible source of cores and cuttings that might aid in enhancing rock property studies in support of geothermal log interpretation.

34795 (SGP-TR—40, pp 125-129) **Development and testing of a small moderate temperature geothermal system.** Harrison, R.F. (Terra Tek, Inc., Salt Lake City, UT); Blair, C.K.; Chapman, D.S. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Geological and geophysical exploration of the Monroe-Red Hill geothermal system in southern Utah has been followed by the drilling of two intermediate depth test holes and the drilling and testing of a 457 meter production well. The test holes confirmed that the hot water system was structurally controlled by the steeply dipping Sevier Fault and suggested that the exploitable reservoir temperature was about 74°C. The production well intersected the top of the Sevier Fault zone at about 305 meters and was successfully completed to 457 meters. Preliminary testing of the production well indicated a reservoir with acceptable storage but somewhat limited permeability.

34796 (SGP-TR—40, pp 343-348) **Fracture detection from geothermal well logs.** Sanyal, S.K. (Stanford Univ., CA); Wells, L.E.; Bickham, R.E. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The state-of-the-art of fracture detection from geothermal well logs is discussed and a case history is provided. A list of various well logs and their response to fractures is presented. (MHR)

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 34800, 34802

34797 (DOE/ID/12018—4) **Geothermal energy potential in the San Luis Valley, Colorado.** Coe, B.A. (Colorado Geological Survey, Denver (USA)). 1980. Contract FC07-79ID12018. 49p. NTIS, PC A03/MF A01.

The background of the area itself is investigated considering the geography, population, economy, attitudes of residents, and energy demands of the area. The requirements for geothermal energy development are considered, including socio-economic, institutional, and environmental conditions as well as some technical aspects. The current, proposed, and potential geothermal energy developments are described. The summary, conclusions, and methodology are included. (MHR)

34798 (ORO—5959-T1) **Geopressured-geothermal energy development: government incentives and institutional structures.** Frederick, D.O.; Prestwood, D.C.L.; Roberts, K.; Vanston, J.H. Jr. (Texas Univ., Austin (USA). Center for Energy Studies). 1979. Contract FG05-78OR05959. 207p. NTIS, PC A10/MF A01.

The following subjects are included: a geothermal resource overview, the evolution of the current Texas geopressured-geothermal institutional structure, project evaluation with uncertainty and the structure of incentives, the natural gas industry, the electric utility industry, potential governmental participants in resource development, industrial users of thermal energy, current government incentives bearing on geopressured-geothermal development, six profiles for utilization of the geopressured-geothermal resources in the mid-term, and probable impacts of new government incentives on mid-term resource utilization profiles. (MHR)

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 34808

34799 (COO—4635-1) **Geothermal Loan Guaranty Program and its impact on geothermal exploration and development.** Nasr, L.H. (Colorado School of Mines, Golden (USA)). May 1978. Contract AC02-78ET27214. 217p. NTIS, PC A10/MF A01.

The study showed that the Geothermal Loan Guaranty Program has had only a negligible effect on geothermal development and the response to the program was far less than expected. The streamlining of environmental regulations and leasing policies, and the granting of intangible drilling cost write-offs and depletion allowances to operators would have had a greater impact on geothermal energy development. The loan guaranty program did not promote the undertaking of any new projects that would not have been undertaken without it. The program only accelerated the pace for some development which might have commenced in the future. Included in the study are recommendations for improving the operation of the program thereby increasing its attractiveness to potential applicants.

34800 (DOE/ID/12101—1) **State geothermal commercialization programs in ten Rocky Mountain states. Semi-annual progress report, July-December 1979.** Griffith, J.L. (comp.). (Western Energy Planners Ltd., Denver, CO (USA); Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office). Aug 1980. Contract AC07-80ID12101. 325p. NTIS, PC A14/MF A01.

The activities and findings of the ten state teams participating in the Rocky Mountain Basin and Range Regional Hydrothermal Commercialization Program for the period are described. A summary of the state projects, compilation of project accomplishments, summary of findings, and a description of the major conclusions and recommendations are presented. Also included are chapters on the commercialization activities carried out by individual teams in each state: Arizona, Colorado, Idaho, Montana, Nevada, New-Mexico, North Dakota, South Dakota, Utah, and Wyoming. (MHR)

34801 (M—78-17) **GELCOM: a geothermal levelized busbar cost model. Description and user's guide.** Gupta, J.N.; Leigh, J.G. (Mitre Corp., McLean, VA (USA). METREK Div.). Jan 1978. Contract AC01-77ET28505. 125p. NTIS, PC A06/MF A01.

The model described is designed to project the costs of electricity generated from liquid dominated hydrothermal resources. It is presented in the form of an interactive computer program called GELCOM, written in Fortran IV, together with an analytic explanation of the methodology. GELCOM starts from resource data and estimates the capital and operating costs for the production field and electrical generating plant. The methodology implemented in GELCOM to determine the engineering cost, operating parameter estimates, and the levelized busbar cost is described. The output displayed by GELCOM for one prospect is explained. The input data files maintained in the computer system and the input data card

formats are included. A sample session with GELCOM and the economic reports which may be generated from the GELCOM are illustrated. A completed listing of the computer program is given in an appendix. (MHR)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 34817, 34820, 34821, 34832, 34839

34802 (CONF-800920—27) **Relationship between the DOE loan guaranty and California Environmental Quality Act environmental review processes.** Mezga, L.J.; Brechbill, R.A. (Oak Ridge National Lab., TN (USA); Department of Energy, San Francisco, CA (USA). San Francisco Operations Office). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From Geothermal Resource Council annual meeting; Salt Lake City, UT, USA (9 Sep 1980).

The US Department of Energy (DOE) is involved in numerous geothermal research, development, demonstration, and loan guaranty projects in the State of California. These projects often require the preparation of both an Environmental Impact Report (EIR), as required by California Environmental Quality Act (CEQA), and an Environmental Assessment (EA) or Impact Statement (EIS) as required under NEPA. DOE adoption or utilization of information contained in EIR's to meet that agency's NEPA requirements and thereby reduce duplication of effort is dependent on four critical issues: (1) the scope of the proposed action analyzed, (2) the completeness of treatment of environmental issues, (3) the level of DOE involvement in EIR preparation, and (4) the timing of DOE involvement in EIR preparation. At this time, several constraints prevent the integration of the DOE Loan Guaranty and CEQA environmental review and documentation processes. First, the time required to complete an EIR (up to 2 years in some cases) is not compatible with DOE's goal of processing loan guaranty applications within a 4 month period. Second, the CEQA process is usually initiated and completed prior to DOE's involvement in the project. Therefore, DOE often has no role in document preparation and must verify the content of an EIR before adopting or using that document and often must prepare a separate DOE EA even though an EIR exists.

34803 (DOE/EA—0117) **Environmental Assessment: geothermal direct heat project, Marlin, Texas.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Resource Applications). Aug 1980. 68p. NTIS, PC A04/MF A01.

The Federal action addressed by this Environmental Assessment (EA) is joint funding the retrofitting of a heating and hot water system in a hospital at Marlin, Texas, with a geothermal preheat system. The project will be located within the existing hospital boiler room. One supply well was drilled in an existing adjacent parking lot. It was necessary to drill the well prior to completion of this environmental assessment in order to confirm the reservoir and to obtain fluids for analysis in order to assess the environmental effects of fluid disposal. Fluid from operation will be disposed of by discharging it directly into existing street drains, which will carry the fluid to Park Lake and eventually the Brazos River. Fluid disposal activities are regulated by the Texas Railroad Commission. The local geology is determined by past displacements in the East Texas Basin. Boundaries are marked by the Balcones and the Mexia-Talco fault systems. All important water-bearing formations are in the cretaceous sedimentary rocks and are slightly to highly saline. Geothermal fluids are produced from the Trinity Group; they range from approximately 3600 to 4000 ppM TDS. Temperatures are expected to be above 64°C (147°F). Surface water flows southeastward as a part of the Brazos River Basin. The nearest perennial stream is the Brazos River 5.6 km (3.5 miles) away, to which surface fluids will eventually discharge. Environmental impacts of construction were small because of the existing structures and paved areas. Construction run-off and geothermal flow-test fluid passed through a small pond in the city park, lowering its water quality, at least temporarily. Construction noise was not out of character with existing noises around the hospital.

34804 (DOE/ET/27224—T1) **Geothermal energy environmental problems and control methods: review of recent findings.** Nguyen, V.T.; Caskey, J.F.; Pfundstein, R.T.; Rifkin, S.B. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1980. Contract AC01-79ET27224. 72p. (MTR—80W108). NTIS, PC A04/MF A01.

The findings of a literature review on the environmental concerns and associated control methods of geothermal energy utilization are presented. The document introduces the environmental problems associated with geothermal energy utilization; assesses the current status of control methods; references appropriate environmental documents; and identifies areas where additional environmental research is needed. The review attempts to consolidate current understanding of the environmental impact of geothermal energy development. Approximately 180 reports written by authors in industry, government and academia have been reviewed in the areas of air emissions, surface and subsurface liquid discharges, solid wastes, noise, subsidence, and induced seismicity.

34805 (EGG—2057) **Analysis of the response of the Raft River monitor wells to the 1979 injection tests.** Spencer, S.G.; Callan, D.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-87ID01570. 33p. NTIS, PC A03/MF A01.

The geothermal resource for the Department of Energy's (DOE) Raft River Geothermal 5 MWe Power Project is located in a closed ground water basin in southcentral Idaho. Chemical analyses indicate the existence of natural communication along fractures between the geothermal reservoir and the shallower aquifers developed for irrigation. Much of the ground water that is presently used for irrigation is of poor quality. Injection of geothermal fluids at intermediate depths may increase communication between the reservoir and the aquifer, resulting in further degradation of shallow ground water quality over time. Seven monitor wells, ranging in depth from 150 m to 400 m, were drilled to evaluate the potential for this degradation. Monitoring of these wells during two 21-day injection tests at the Raft River Geothermal Injection Well-6 (RRGI-6) indicates two types of response in the shallow aquifer system. First, the water level in Monitor Well-4 (MW-4) increased an average of 0.4 m/week during injection, indicating direct fracture connection between the injection zone and the aquifer penetrated by MW-4. Second, water levels in MW-5, MW-6, and MW-7 showed a step function decrease which coincided with the period of the injection tests. Analyses indicate that this response may be caused by elastic deformation in the aquifer matrix.

34806 (SGP-TR—40, pp 275-281) **Injection performance in the Bulalo Geothermal Field, Makiling-Banahao Area, Philippines.** Messer, P.H. (Philippine Geothermal, Inc., Manila). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The Bulalo Field is located within the Makiling-Banahao geothermal prospect approximately sixty kilometers southeast of Manila on the main island of Luzon in the Philippines. This hot brine resource is being explored and developed by Philippine Geothermal Incorporated (PGI), a subsidiary of the Union Oil Company of California. During the past five years, forty-two wells have been drilled and completed into the Bulalo heat anomaly. Commercial production was initiated in late April 1979 to supply steam for the operation of the first generating plant composed of two 55 MW units. Field expansion continues for the installation of an additional plant of similar capacity. Commercial production to date has been primarily limited to ten wells and brine for disposal has been injected into four wells. These four injectors are currently deemed as temporary disposal wells which will handle the brine injection requirements until the permanent system is in operation.

34807 (UCRL—83941(Rev.1)) **Ecology problems associated with geothermal development in California.** Shinn, J.H.; Ireland, R.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Aug 1980. Contract W-7405-ENG-48. 14p. (CONF-800867—1(Rev.1)). NTIS, PC A02/MF A01.

From Symposium on energy and ecology in the West; Tucson, AZ, USA (4 Aug 1980).

Geothermal power plants have the potential for supplying about 5% of the US electrical generating needs by 1985, and are even now supplying about one third of San Francisco's electricity. Investigations have shown that the typical geothermal field, such as the hot water resource of Imperial Valley, can be developed in an environmentally sound manner when proper considerations are made for ecosystem problems. Experimental evidence is presented pro and con for potential impacts due to habitat disturbance, power-line corridors, noise effects, trace element emissions from cooling towers, accidental brine discharges into aquatic or soil systems, competition for water and H_2S effects on vegetation. A mitigation and control strategy is recommended for each ecological issue and it is shown where effects are likely to be irreversible.

GEOTHERMAL POWER PLANTS

34808 (MTR—7689) **Comparative analysis of energy costing methodologies.** El-Sawy, A.H.; Leigh, J.G.; Trehan, R.K. (Mitre Corp., McLean, VA (USA). METREK Div.). Feb 1979. Contract AC01-77ET28505. 113p. NTIS, PC A06/MF A01.

The methodologies used for computing levelized busbar costs of electricity from geothermal (hydrothermal) resources used by 16 organizations active in the geothermal area are discussed. The methodologies are compared by (a) comparing the results obtained by using two standard data sets, (b) a theoretical analysis of the mathematical formulation of the embedded models, and (c) an examination of differences in data and assumptions. The objective is to

attempt to resolve differences in estimates of geothermal (and conventional) electric power costs, upon which policies may be formulated and research, development and demonstration activities designed and implemented.

34809 (SGP-TR—40, pp 257-260) **Status report on geothermal development in the Valles Caldera, New Mexico.** Atkinson, P.G.; Gulati, M.S. (Union Oil Co., Santa Rosa, CA). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The geology and hydrology of the geothermal system are reviewed briefly. The initial development plans and the geothermal demonstration power plant are discussed. (MHR)

POWER PLANT SYSTEMS AND COMPONENTS

34810 Direct contact, binary fluid geothermal boiler. Rapier, P.M. US Patent Application 107,791. 27 Dec 1979. 27p.

Energy is extracted from geothermal brines by direct contact with a working fluid such as isobutane which is immiscible with the brine in a geothermal boiler. The geothermal boiler provides a distributor arrangement which efficiently contacts geothermal brine with the isobutane in order to prevent the entrainment of geothermal brine in the isobutane vapor which is directed to a turbine. Accordingly the problem of brine carryover through the turbine causing corrosion and scaling thereof is eliminated. Additionally the heat exchanger includes straightening vanes for preventing startup and other temporary fluctuations in the transitional zone of the boiler from causing brine carryover into the turbine. Also a screen is provided in the heat exchanger to coalesce the working fluid and to assist in defining the location of the transitional zone where the geothermal brine and the isobutane are initially mixed.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

34811 (BNL—51153) **Phosphate-bonded glass cements for geothermal wells. Final report.** Rockett, T.J. (Rhode Island Univ., Kingston (USA). Dept. of Materials and Chemical Engineering). Sep 1979. Contract AC02-76CH00016. 73p. NTIS, PC A04/MF A01.

Calcium aluminosilicate glasses were found to react with phosphoric acid in three ways depending upon silica content. Above 55% SiO_2 they are insoluble while below 50% they dissolve readily. The transition compositions release calcium and aluminum ions and a silica gel phase replaces the glass. Activation energies in the order of 10 kcal/mole are associated with the dissolution. Equilibrium studies in the systems $CaO-P_2O_5-H_2O$, $Al_2O_3-P_2O_5-H_2O$, and $CaO-Al_2O_3-P_2O_5-H_2O$ were made to determine the phases which are stable at 200°C in excess water. The CaO system shows hydroxylapatite, monetite and monocalcium orthophosphate are the stable phases. The Al_2O_3 system contains augelite, berlinite, and a high phosphate aluminum hydrate. The quaternary system shows the above phase plus a lime alumina hydrogarnet and crandallite. Cement made from a glass frit of the composition 45% SiO_2: 24% CaO: 24% Al_2O_3 has a compressive strength of 500 psi after several days in steam at 200°C and 800 psi after months in steam. Bonding of cements to mild steel are discussed.

34812 (DOE/ET/28505—T1) **WELCST: engineering cost model of geothermal wells. Description and user's guide.** Entingh, D.J.; Lopez, A. (Mitre Corp., McLean, VA (USA). METREK Div.). Feb 1979. Contract AC01-77ET28505. 146p. (M—78-86). NTIS, PC A07/MF A01.

WELCST, a FORTRAN code for estimating the effects of R and D project results upon the future cost of geothermal wells is described. The code simulates the drilling and completion of a well at 27 specific US geothermal prospects, given assumptions about well design and casing plan, formation drillability, and selected engineering and cost characteristics of today's drilling technology. The user may change many of the assumptions about engineering and cost characteristics to allow WELCST to simulate impacts of specific R and D projects on the estimated cost of wells at the prospects. An important capability of WELCST is that it simulates rates and costs of major drilling mishaps, based on drilling incident data from the Imperial Valley and Geysers geothermal fields. WELCST is capable of estimating geothermal well costs at liquid-dominated (hydrothermal) sites, vapor-dominated sites, geopressured sites, and Hot Dry Rock sites. The model can contribute to many system-optimization studies, and could be easily adapted to estimate well costs outside of the United States.

34813 (SAND—80-1234) **Geothermal drilling and completion technology development program. Quarterly progress report, April-June 1980.** Varnado, S.G. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 281p. NTIS, PC A13/MF A01.

The progress, status, and results of ongoing research and development (R and D) within the Geothermal Drilling and Completion Technology Development Program are reported. The program emphasizes the development of geothermal drilling hardware, drilling fluids, completion technology, and lost circulation control methods. Advanced drilling systems are also under development. The goals of the program are to develop the technology required to reduce well costs by 25% by 1983 and by 50% by 1987.

34814 (SAND—80-1581C) **Geothermal drilling research in the United States.** Varnado, S.G. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 32p. (CONF-801023—1). NTIS, PC A03/MF A01.

From 2. Latin American congress on drilling; Mexico City, Mexico (Oct 1980).

Current research and development in the following areas are presented: geothermal roller cone bits, polycrystalline diamond compact bits, a continuous chain drill, drilling fluids test equipment, mud research, inert fluids, foam fluids, lost circulation control, completion technology, and advanced drilling and completion systems. (MHR)

34815 (SAND—80-7058) **Drilling fluid/formation interaction at simulated in situ geothermal conditions. Final report.** Enniss, D.O.; Bergosh, J.L.; Butters, S.W.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jul 1980. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01.

Interaction of drilling fluids with a geothermal reservoir formation can result in significant permeability impairment and therefore reduced well productivity. This interaction is studied under simulated in situ geothermal conditions of overburden stress, pore fluid pressure, temperature, and pore fluid chemistry. Permeability impairment of an East Mesa KGRA reservoir material is evaluated as a function of stagnation time, drilling fluid, and temperature. Results indicate that all of these parameters contribute significantly to the magnitude and the reversibility of the impairment.

34816 (SGP-TR—40, pp 61-69) **Use of observation well data in determining optimum well spacing and recharge in a geothermal field (Cerro Prieto).** Saltuklaroglu, M. (Elc-Electroconsult, Milan, Italy). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Change of standing water level or pressure in an observation well within the drainage area of an exploited field can be analyzed to give an important well parameter which relates recharge, storativity, and total field drainage area. This parameter then can be used to determine the optimum well spacing within the field, assuming that the production rate and enthalpy do not change appreciably during the foreseen economic life of the field, and that the field can be considered approximately isotropic and pseudo-porous. An example of this application is given using the data of the Cerro Prieto Geothermal Field, Baja California, Mexico, between May 1974 and March 1977. Although one expects changes in both enthalpy and production rate in years to come (usually a decline in production rate and an increase in enthalpy), the figures obtained may serve as first approximations of guidelines for the field development.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 34772, 34775, 34777

34817 (SGP-TR—40) **Proceedings of fifth workshop on Geothermal Reservoir Engineering, December 12-14, 1979.** Ramey, H.J. Jr.; Kruger, P. (eds.). (Stanford Univ., CA (USA). Stanford Geothermal Program). 1979. Contract AT03-76ET28364. 393p. (CONF-791235—). NTIS, PC A17/MF A01.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Forty-four papers are included. Two papers were abstracted for EDB previously. Separate abstracts were prepared for forty-two. (MHR)

34818 (SGP-TR—40, pp 7-12) **Status of Geothermal Reservoir Engineering Management Program (GREMP), December 1979.** Howard, J.H.; Schwarz, W.J. (Univ. of California, Berkeley). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

In the fall of 1976, the US Department of Energy (DOE), Division of Geothermal Energy (DGE) proposed that Lawrence Berkeley Laboratory (LBL) assume lead responsibility, on DGE's behalf, for the management of a program of support of research related to geothermal reservoir engineering. Since its inception, this activity, known as GREMP has included 18 separate contracts on a variety of technical and scientific projects. Altogether, 23 distinguishable research topics have been addressed. Fourteen institutions, including eight private companies, have contracted with the program. The status of the work as of December 1979 is summarized.

All high priority elements of the original program that were assigned to LBL for implementation have been addressed except for investigations of properties of materials. In the future the program should emphasize this neglected element as well as assure meaningful evaluation, preferably in the field, of the applicability of research supported to date.

34819 (SGP-TR—40, pp 13-27) **Analysis of a slug test or drill stem test for linear flow.** Barelli, A. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

A means is provided for analyzing pressure transients from drill stem tests (DSTs) in fractured wells dominated by linear flow in the formation. The consequent partial differential equations have been solved by numerical inversion of the Laplace transform. A DST consists of isolating an open stretch of borehole with packers and connecting it instantaneously with the atmosphere by means of a drill-string. In water-dominated reservoirs, at the end of the test a level usually stabilizes in the string and the well does not produce spontaneously. The method can be applied only to the analysis of DSTs in which the fluid influx into the drill pipe tends to kill the flow, giving only a partial DST recovery. The analysis is performed by type-curve matching, and leads to the determination of the initial reservoir pressure, flow characteristics of the formation, and wellbore damage. These parameters allow the prediction of early-time pressure drawdown due to a constant flowrate.

34820 (SGP-TR—40, pp 29-39) **Injection capability at the Raft River Geothermal Site.** Ahmed, U.; Wolgemuth, K.M.; Abou-Sayed, A.S.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The Raft River Geothermal Resource Area in southern Idaho is the first location for an electric power plant utilizing a medium temperature (≃ 145°C) geothermal resource. For the projected 5 MWe pilot geothermal plant, a supply of 2500 gpm of the geothermal fluid is needed. The State of Idaho prefers that the spent brine be reinjected into zones deeper than the known agricultural aquifers. Wells RRGI-6 and 7 are to be used for injection. The objective of this study is to evaluate the injection capability of the formation. An analysis is presented of several injectivity tests performed by EG and G on RRGI-7 to characterize the injection capability of the formation. The available geological information about the area and preliminary results of a spinner survey have been included in the injectivity test analysis. A wellhead pressure limit of 500 psi has been imposed to prevent injection formation fracturing. The approach to analysis is to use a two dimensional radial numerical simulator with parameters determined by the test results and from geological data.

34821 (SGP-TR—40, pp 41-47) **Reinjection testing at Broadlands.** Bixley, P.F. (Ministry of Works and Development, Wairakei, New Zealand); Grant, M.A. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Testing of various systems has been underway at Broadlands since 1974, and allied silica deposition investigations have been continuing at Wairakei and Broadlands since 1971. To date, three major tests have been done: BR7, 3 years injecting separated and cooled water at approximately 120°C and 26 t/h; BR33, 6 months injecting both chemically treated and untreated water after flashing to atmospheric pressure, at a rate of 170 t/h; and BR34, 2 months injecting water flashed to atmospheric pressure, but not exposed to the atmosphere, at a rate of 210 t/h. Recent short term tests at BR13 and 23 have provided more data on permeability changes while injecting geothermal water. In all tests water supersaturated with silica has been injected, and in only one case was any detrimental effect in the injection formation detected. In one other case there was no measurable change in permeability of the injection formation and in the remaining tests, pressure transient analysis has shown an increasing permeability with time.

34822 (SGP-TR—40, pp 49-59) **Interference effect of producing wells on observation wells in a geothermal field (Cerro Prieto).** Saltuklaroglu, M. (Elc-Electroconsult, Milan, Italy). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Interference effects of producing wells on an observation well in a geothermal field where the producing formations are porous, naturally fractured, and without much anisotropy can be calculated using the already established pressure-time-mass flow equations for slightly compressible fluids flowing in porous or pseudo-porous formations. When the results are correlated with pressure or water level decline in the observation well, a fundamentally important parameter of the reservoir is obtained. This parameter relates recharge and storativity of the reservoir and can be used in determining the optimum well spacing. The approach is illustrated with an example from Cerro Prieto Geothermal Field, Baja California, Mexico.

34823 (SGP-TR—40, pp 71-84) **Well interference test in the Chingshui geothermal field.** Chang, C.R.Y. (Chinese Petroleum Corp., Taiwan); Ramey, H.J. Jr. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Short-time pressure testing frequently provides inaccurate information on deliverability (permeability thickness or transmissivity), while long-term production testing is required to establish reserves. Fortunately, an interference test is a type of pressure transient test than can be accomplished in a reasonable period of time, and yet provide important information concerning apparent reserves early in the life of a geothermal development. The main purpose of this study is to illustrate the interpretation of interference tests.

34824 (SGP-TR—40, pp 85-90) **Capacitive perturbations in well interference testing.** Bodvarsson, G. (Oregon State Univ., Corvallis). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The capacitive effects were discussed from a rather general point of view and, in particular, to derive some basic expressions to enable us to correct for pressometer and soft-spot capacitance. The approach is based on the assumption of a forward type interpretational procedure. In other words, the development is based on definite field models that lead to a well-posed problem setting. By varying the model parameters, the solutions yield the type-curves that are used to interpret field data. Data interpretation on the basis of so-called inverse procedures is usually not feasible and would lead to a practically impossible problem setting. (MHR)

34825 (SGP-TR—40, pp 91-97) **Two short-time buildup test analyses for Shell's Geysers Well D-6, a year apart.** Economides, M.J.; Fehlberg, E.L. (Shell Oil Co., Houston, TX). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Pressure transient tests of Shell's geothermal Well D-6 were conducted in the Summer of 1978 and again in early Summer of 1979. On both occasions a pressure buildup test followed a short drawdown period. Analysis of the pressure data resulted in the calculation of the permeability-thickness product, the skin effect and the initial reservoir pressure. The analysis that led to the calculation of these reservoir parameters is presented. There is reasonable agreement between the two tests while observed changes were in the expected direction. The reduced data revealed a well that is within the norms of The Geysers area.

34826 (SGP-TR—40, pp 99-104) **Analysis of Gabbro 1: steam pressure buildup test.** Moench, A.F. (Geological Survey, Menlo Park, CA); Neri, G. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

A pressure-buildup test which was run on a well located in the Gabbro zone (north of the old Larderello field) shows a pressure plateau which may be due to condensation in the reservoir. Analysis of this test makes use of the model proposed by Moench (1978) which assumes that steam vaporizes from thin, highly-permeable, porous fissures that surround blocks of impermeable rock. Heat is transferred from the blocks to the fissures by conduction.

34827 (SGP-TR—40, pp 105-112) **Pressure buildup tests of well CPC-CS-4T, Chinshui geothermal field.** Shen, K.Y.; Chang, C.R.Y. (Chinese Petroleum Corp., Miaoli, Taiwan). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Well CPS-CS-4T is located in the Chinshui Geothermal Field in the northeast of Taiwan. The first deep well drilled in this area, its total depth is 1505 m. The well was spudded on April 16, 1976, and completed with 7 in. liner hanger and slotted liner on June 17, 1976. The production hole is from 539 to 1505 m. Eight centralizers were used during setting of the 9-5/8 in. production casing in a 12-1/4 in. hole at 529 m. The full casing cement job was performed with silica flour cement, with a slurry weight of 1.60 specific gravity. About 10 kiloliters of cement slurry was flowed out at the surface through the annulus during cementing. This implied that a good cement job had been done. In drilling the 8-1/2 in. production hole, much lost circulation was encountered. A total of 740 kiloliters of drilling mud was lost between the drilling interval from 724 m to the total depth. The main loss zone was from 750 to 800 m. The weight of the lost mud was between a specific gravity of 1.06 and 1.15. The reservoir is within the Lushan formation, of Miocene age. The lithologies encountered are all dark gray slate, slightly intercalated with light gray fine-grained to very fine-grained compact sandstone. It is a water-dominated geothermal reservoir. Temperature and pressure-depth surveys were performed during flow tests. These data were plotted on the phase diagram of water. Flash points between the surface and 230 m were observed clearly. Thus single-phase flow in the reservoir is evident.

34828 (SGP-TR—40, pp 113-124) **Analysis of the pressure transient testing of a man-made fractured geothermal reservoir.** Fisher, H.N.; Tester, J.W. (Los Alamos Scientific Lab., NM). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Pressure-transient testing of a hydraulically fractured geothermal reservoir in low-permeability crystalline basement rock has involved constant rate injection and pressure buildup tests under a wide range of field conditions for a number of fractured regions. Following conventional reservoir analysis methods, data are treated in terms of a transient diffusion equation that relates fluid flow and pressure levels in the main fracture system, associated joints, and the matrix permeability. Pressure-flow data are compared to type curve solutions of the diffusion equation for various flow geometries. The following points are considered in detail: (1) the limits on the fracture geometry, aperture and diffusing areas as determined from the diffusion parameters; (2) the parameters (flow impedance, diffusivity) of the flow-through systems are related to those governing the pressure inflation of the main fractures; (3) the relationship of the rock properties to the reservoir compressibility, effective porosity and permeability are discussed. In particular, laboratory experiments show that the flow properties of all sizes of cracks from large single fractures to the microstructure are pressure dependent if the fluid pressure is near the confining stress; and (4) the competition of flow into the various types of porosity (main fractures, joints, and microstructure) and the effect on the interpretation of type curves are discussed.

34829 (SGP-TR—40, pp 139-151) **Shut-in and flowing bottom hole pressure calculation for geothermal steam wells.** Economides, M.J. (Shell Oil Co., Houston, TX). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Four calculation procedures for the estimation of bottom hole pressures are presented. Two of the methods are for static pressure, suitable for buildup analysis, while the remaining two are for flowing wells. In both cases, the first procedure is the established, classic technique followed by a novel correlation, tailored to suit wells that operate at either saturated or slightly superheated conditions. These correlations are particularly applicable to the reservoirs in The Geysers area, where the properties of the geothermal fluid closely match the assumptions.

34830 (SGP-TR—40, pp 153-160) **Design and construction of a mobile test capability for determining the characteristics of geothermal fluids and reservoirs.** Tom Kuo, M.C. (Occidental Research Corp., La Verne, CA); La Mori, P.; Okazaki, J. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Two mobile test facilities were designed and constructed for determining the characteristics of geothermal fluids and reservoirs, i.e., temperature, pressure, flow rate, enthalpy, and chemistry. The initial efforts were directed towards identification of the phases of geothermal development and the quantification of requirements for testing and measurement during these phases. It was during this period that the need that the mobile test capability be split into two units was identified. The first unit is the Mobile Chemical Analysis Trailer, CAT, which has the capability of measuring the chemical composition of geothermal brines and other waters, e.g., hot springs. One of its major functions will be to accurately prepare samples for shipment for more detailed chemical analysis. The second unit is the Geothermal Energy Evaluation Prototype, GEEP, which is used for determination of flow rate, enthalpy, temperature, pressure of the geothermal reservoir and recovery of samples for chemical analysis. The phases of geothermal development and how the CAT and GEEP interact to obtain the required information are shown. It is shown that as field development progresses additional larger size process test units will be required to provide final design information for the power plants and field development. (MHR)

34831 (SGP-TR—40, pp 161-172) **Power plant oriented geothermal simulation model.** Liguori, P.E; Antonelli, G. (ELC-Electroconsult, S.p.A., Milan, Italy). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

To be useful for power plant planning and design, a simulation model must include both a geothermal reservoir and wells, maintaining constant wellhead pressure and varying flow. The well model allows for vertical single- or two-phase flow under steady state, and the reservoir model allows for horizontal axisymmetrical radial single- or two-phase nonisothermal flow under transient conditions. The simulation permits prediction of reservoir evolution on the basis of the first well test results, such as: (1) permeability, porosity, thickness; and (2) static pressure and temperature. The other required input is one of the following versus time: (1) wellhead pressure; (2) power plant output; or (3) wellhead flow. The output consists of the simulated history of pressure, saturation, and temperature fields (the latter both for rocks and fluid). The model has been tested against the actual behavior of a geothermal reservoir.

34832 (SGP-TR—40, pp 189-196) **Block response to reinjection in a fractured geothermal reservoir.** Pinder, G.F. (Princeton Univ., NJ); Ramey, H.J. Jr.; Shapiro, A.; Abriola, L. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

While fractured porous formations constitute an important class of geothermal reservoirs, a generally applicable methodology for accurately describing their performance has yet to appear in the literature. As a preliminary step in an attempt to unravel the fundamental physical principles involved in fractured media simulation, an elementary numerical experiment is described. A porous media block containing superheated steam is suddenly enclosed by reinjection water of lower enthalpy. The objectives of the experiment are: (1) to examine the response of the porous block to reinjection; and (2) to study the influence of block geometry on the simulated behavior. The numerical experiments are conducted using a one-dimensional multiphase (steam-water) model. With the model defined in Cartesian coordinates, a porous block delimited by two parallel fractures of infinite extent is investigated. The model defined in radial coordinates is employed to examine a cylindrical geometry. The reservoir parameters and reinjection water properties are chosen to be representative of those encountered in The Geysers geothermal field in California.

34833 (SGP-TR—40, pp 197-203) **Sensitivity study of variables affecting fluid flow in geothermal wells.** Sanyal, S.K. (Stanford Univ., CA); Brown, S.; Fandriana, L.; Juprasert, S. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Behavior of flow was simulated in a direct use well using a numerical well bore simulator, an older version of which had been described before. The well studied was Bostic 1-A at Mountain Home, Idaho. This well had been chosen as a supply well for a USDOE-financed feasibility study of a direct geothermal use program. The well is 9678 feet deep and 8-3/4 inches in diameter with a maximum temperature of 372°F at 8,898 ft. A drill stem test was inconclusive and the well had not flowed before. It was decided to forecast the condition of the well effluent for various assumed flow rates so that, if the well could be made to flow, optimum production condition could be specified and the adequacy of the well for the proposed project assessed. (MHR)

34834 (SGP-TR—40, pp 205-209) **Technical analysis of geothermal production data by decline curve methods.** Zais, E.J. (Elliot Zais and Associcates, Inc., Corvallis, OR). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

This project is an attempt to test traditional oil field decline curve methods on geothermal production data and develop new methods if necessary. Large data sets from Wairakei, New Zealand, and Cerro Prieto, Mexico along with a handful of sets from Larderello and Otake are available. Other data are being sought.

34835 (SGP-TR—40, pp 261-267) **Interpretation of downhole measurements at Baca.** Grant, M.A. (Department of Scientific and Industrial Research, Wellington, New Zealand). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Two idealized conceptional models are described, to give a background idea of expected reservoir fluid state. A full set of measurements on Baca Field, New Mexico, has been released. These measurements are used to illustrate interpretation, and construct a conceptual model of Baca reservoir. Baca is a liquid-dominated reservoir, with a two-phase region containing the best producers. No abnormally pressured zone has yet been penetrated by drilling.

34836 (SGP-TR—40, pp 299-303) **Aquifer boiling may be normal in exploited high-temperature geothermal systems.** Truesdell, A.H. (Geological Survey, Menlo Park, CA). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The Wairakei hot-water system is discussed as an atypical field. In more normal hot-water systems, such as Cerro Prieto or Broadlands, aquifer boiling is the rule. The characteristics of this boiling are discussed. (MHR)

34837 (SGP-TR—40, pp 349-357) **Application of two-phase critical flow models for the determination of geothermal wellbore discharge characteristics.** Cheng, P.; Karmarkar, M. (Univ. of Hawaii, Honolulu). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Further work on the comparison of James' formulas with other two-phase critical flow models wasperformed and also the effects of noncondensable gases in wellbore discharge were investigated. (MHR)

34838 (SGP-TR—40, pp 367-372) **Application of the Horner method to the estimation of static reservoir temperature during drilling**

operations. Chiang, C.Y.; Chang, C.R.Y. (Chinese Petroleum Corp., Miaoli, Taiwan). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

When drilling a geothermal well, it is important to know, roughly, the original formation temperature prior to setting casing pipes. The interface of the cold water zone and the hot formation should be determined during drilling so that casing and full cement jobs can be designed satisfactorily. During drilling, heat in the formation flows into the circulating fluid. When the pump is stopped for drill pipe trips or for any other reason, the temperature of the static fluid in the hole will rise continuously. From a mathematical viewpoint, this phenomenon is similar to the pressure buildup through porous media when a fluid flowing well is shut in. The static reservoir pressure could be extrapolated from the Horner pressure-time straight line on a semilog graph; thus the static formation temperature could also be estimated in the same manner. The temperature recovery surveys should be performed once every 10 m interval in the open hole. This means many semilog graphs will be done: tiresome work open to miscalculation by the engineer. A hand-computer program capable of making the necessary computations is presented. The program is written for the HP-65 hand computer. The derivation of the equation used to compute the original formation temperature is shown. (MHR)

34839 (SGP-TR—40, pp 385-389) **Reinjection strategy.** Russell, J. (Department of Scientific and Industrial Research, Wairakei, New Zealand). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Because of the complexity of underground conditions within a geothermal reservoir, reinjection is difficult to explain scientifically. Its ultimate purpose is usually for large-scale employment in a field developed and generating electrical energy; therefore, small-scale ad hoc experiments are remote from the final conditions envisaged. The reservoir up-flow of hot water from large discharges of numerous production wells cannot be duplicated except in existing fields such as Wairakei. Hence the argument presented here is that it is only at Wairakei that progressive tests are valid. But parallel tests on the undeveloped Broadlands field should be undertaken with reinjection into the reservoir with production and injection wells interchanged. The emphasis is on maximum scientific returns at minimum cost; otherwise, highly expensive investigations may lead to eventual abandonment of a project.

34840 **Thermodynamic behaviour of the Bagnore geothermal field.** Atkinson, P.; Celati, R.; Corsi, R.; Kucuk, F.; Ramey, H.J. Jr. (Stanford Univ, Calif). *Geothermics*; 7: No. 2-4, 185-208(1978). (CONF-7709210—).

From DOE workshop on geothermal resources assessment and reservoir engineering; Larderello, Italy (12 Sep 1977).

This paper describes Italy's Bagnore geothermal field. Thermodynamic and chemical equilibrium conditions were used to investigate the field behavior quantitatively. Chemical equilibrium calculation indicate that the CO_2, liquid carbonate ionic species, and carbonate rocks, are in equilibrium with one another. Thermodynamic considerations were used to evaluate the evolution of the field as fluid was produced. These calculations support the hypothesis that the initial decline in field pressure and producing CO_2 content was caused by a "blowdown" of the gas cap. A mathematical lumped-parameter model of the Bagnore field was successfuly developed. This model is able to accurately reproduce the observed field history.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

34841 (DOE/AL/10563—T3(Vol.1)) **Geothermal Reservoir Well Stimulation Program: technology transfer.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA); Petroleum Training and Technical Services, Norman, OK (USA)). May 1980. Contract AC32-79AL10563. 137p. NTIS, PC A07/MF A01.

The following are included: review of available data from previous fracturing stimulation operations, stimulation process variables, fracturing fluid design, hydraulic fracture design, stimulation case histories, and selected bibliography. (MHR)

34842 (DOE/AL/10563—T3(Vol.2)) **Geothermal Reservoir Well Stimulation Program: technology transfer.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA); Petroleum Training and Technical Services, Norman, OK (USA)). May 1980. Contract AC32-79AL10563. 58p. NTIS, PC A04/MF A01.

To assess the stimulation technology developed in the oil and gas industry as to its applicability to the problems of geothermal well stimulation, a literature search was performed through on-line computer systems. Also, field records of well stimulation programs that have worked successfully were obtained from oil and gas operators and service companies. The results of these surveys are presented. (MHR)

34843 (DOE/AL/10563—T3(Vol.3)) **Geothermal Reservoir Well Stimulation Program: technology transfer.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA); Vetter Research, Costa Mesa, CA (USA)). May 1980. Contract AC32-79AL10563. 81p. NTIS, PC A05/MF A01.

A literature search on reservoir and/or well stimulation techniques suitable for application in geothermal fields is presented. The literature on stimulation techniques in oil and gas field applications was also searched and evaluated as to its relevancy to geothermal operations. The equivalent low-temperature work documented in the open literature is cited, and an attempt is made to evaluate the relevance of this information as far as high-temperature stimulation work is concerned. Clays play an important role in any stimulation work. Therefore, special emphasis has been placed on clay behavior anticipated in geothermal operations. (MHR)

34844 (DOE/AL/10563—T3(Vol.4)) **Geothermal Reservoir Well Stimulation Program: technology transfer.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA); Maurer Engineering, Inc., Houston, TX (USA)). May 1980. Contract AC32-79AL10563. 140p. NTIS, PC A07/MF A01.

Each of the following types of well stimulation techniques are summarized and explained: hydraulic fracturing; thermal; mechanical, jetting, and drainhole drilling; explosive and implosive; and injection methods. Current stimulation techniques, stimulation techniques for geothermal wells, areas of needed investigation, and engineering calculations for various techniques. (MHR)

34845 (SGP-TR—40, pp 317-325) **Progress in studies of energy extraction from geothermal reservoirs.** Nelson, D.V.; Hunsbedt, A. (Stanford Univ., CA). 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

It is important to determine experimentally: (a) the conditions under which cracking will occur; (b) the compatibility of these conditions with expected operating conditions of reservoirs; and (c) the extent to which energy extraction can be enhanced by cracking. In order to begin a study of items (a) through (c), the behavior of granite samples subjected to thermal stressing was investigated. In particular, the fracture strength and porosity of the samples were explored for various combinations of rock temperature and quenching severity. (MHR)

34846 (SGP-TR—40, pp 373-384) **Improved approach to estimating true reservoir temperature from transient temperature data.** Roux, B. (Atlantic Richfield Co., Los Angeles, CA); Sanyal, S.K.; Brown, S. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

The development of an improved approach so that the estimated static temperature will be closer to the true reservoir temperature than is possible from the conventional Horner plot is discussed. The solution presented is based on a conductive model. A calculation procedure is outlined. (MHR)

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 34803, 34833

34847 (DOE/ET/28455—3) **Residential and commercial space heating and cooling with possible greenhouse operation; Baca Grande development, San Luis Valley, Colorado. Final report.** Goering, S.W.; Garing, K.L.; Coury, G.E.; Fritzler, E.A. (Coury and Associates, Lakewood, CO (USA)). May 1980. Contract AC07-78ET28455. 288p. NTIS, PC A13/MF A01.

A feasibility study was performed to evaluate the potential of multipurpose applications of moderate-temperature geothermal waters in the vicinity of the Baca Grande community development in the San Luis Valley, Colorado. The project resource assessment, based on a thorough review of existing data, indicates that a substantial resource likely exists in the Baca Grande region capable of supporting residential and light industrial activity. Engineering designs were developed for geothermal district heating systems for space heating and domestic hot water heating for residences, including a mobile home park, an existing motel, a greenhouse complex, and other small commercial uses such as aquaculture. In addition, a thorough institutional analysis of the study area was performed to highlight factors which might pose barriers to the ultimate commercial development of the resource. Finally, an environmental evaluation of the possible impacts of the proposed action was also performed. The feasibility evaluation indicates the economics of the residential areas are dependent on the continued rate of housing construction. If essentially complete development could occur over a 30-year period, the economics are favorable as compared to existing alternatives. For the commercial area, the economics are good as compared to existing conventional energy sources. This is especially true as related to proposed greenhouse operations. The

institutional and environmental analyses indicates that no significant barriers to development are apparent.

GEOTHERMAL DATA AND THEORY

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 34791, 34845

34848 (SGP-TR—40, pp 305-315) **Resistivity of brine saturated rock samples at elevated temperatures.** Ucok, H.; Ershaghi, I.; Olhoeft, G.R. 1979.

From 5. geothermal reservoir engineering workshop; Stanford, CA, USA (12 Dec 1979).

Electrical resistivities of rock samples saturated with NaCl solution have been measured at 1 KHz and under 31 MPa hydrostatic pressures and at temperatures up to 350°C. The samples included Berea sandstone, Boise sandstone, cores from the Cerro Prieto geothermal field, Mexico, and Hawaiian basalt. The mineralogical composition of the samples were determined by x-ray diffraction analysis. Since the overall behavior of saturated rock samples is influenced by the saturating fluid, data from a previous study on the electrical resistivity of brines as a function of temperature are included here. In general, the resistivity of the samples decrease sharply between 25 to 200°C. The rate of decrease slows down considerably beyond this temperature and then a slight increase in resistivity is noticeable above 300°C. The general behavior of the saturated rock samples shown above is very similar to the behavior of the saturating fluid. Formation resistivity factor decreases with temperature up to 150 to 175°C and then stabilizes at higher temperature. (MHR)

TIDAL POWER

WAVE ENERGY CONVERTERS

34849 (AD-A—078058) **Wave power extraction by floating bodies. Technical report.** Mei, C.C.; Newman, J.N. (Massachusetts Inst. of Tech., Cambridge (USA). Ralph M. Parsons Lab. for Water Resources and Hydrodynamics). Nov 1979. Contract N00014-76-C-0214. 27p. NTIS, PC A03/MF A01.

The linearized theory of water waves is reviewed in the context of wave-energy absorbers. A global analysis is outlined, leading to relatively simple expressions for the maximum energy absorption. Calculations are presented for the performance of Salter cam in two dimensions, and of a Cockerell raft in both two and three dimensions. Similar rates of optimum energy absorption are anticipated for other devices including the Kaimei ship and French air bag.

34850 (DOE/ET/21019—T1) **Wave power extraction from a transient heaving cylinder.** Hudspeth, R.T.; Slotta, L.S. (Oregon State Univ., Corvallis (USA)). Jan 1980. Contract AP01-79ET21019. 18p. NTIS, PC A02/MF A01.

Wave power extracted from the transient motion of a periodically restrained-released heaving circular cylinder proposed by Falnes and Budal is examined under the limitations of linear wave theory excitation. Numerical estimates for the normalized radiated wave amplitudes required for the waveforce excitation derived by Mei are computed from the computationally efficient variational method developed by Black and Mei for the wave force diffraction regime. Wave power estimates for the rising period only of the heaving motion are given; while the falling period of the motion is neglected. A graphical summary is presented which demonstrates the parametric dependency of the dimensionless wave power rate on the design wave parameters and the body geometry for three general types of transient power systems heaving in deep water conditions. The total power requirements for the complete power extraction system as well as the real fluid viscous effects are not included.

WIND ENERGY

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 34628

34851 (AD-A—078346/4) **Mildenhall RAF, Mildenhall, United Kingdom. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 22 Dec 1978. 411p. NTIS, PC AA18/MF A01.

This report is a six-part statistical summary of surface weather observations for Mildenhall RAF, Mildenhall, United Kingdom. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34852 (AD-A—078347/2) **Vicenza, Italy. revised uniform summary of surface weather observations (RUSSWO). parts a, c-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 1 Feb 1979. 384p. NTIS, PC AA17/MF A01.

This report is a six-part statistical summary of surface weather observations for Vicenza, Italy. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34853 (AD-A—078348/0) **Bentwaters RAF, Woodbridge, united kingdom. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 24 Oct 1978. 408p. NTIS, PC AA18/MF A01.

This report is a six-part statistical summary of surface weather observations for Bentwaters RAF, Woodbridge, United Kingdom. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34854 (AD-A—078349/8) **Fairford RAF, Swindon, United Kingdom. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 5 Mar 1979. 405p. NTIS, PC AA18/MF A01.

This report is a six-part statistical summary of surface weather observations for Fairford RAF, Swindon, United Kingdom. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34855 (AD-A—078350/6) **Alconbury RAF, Hyntingdon, United Kingdom. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 30 Nov 1977. 410p. NTIS, PC AA18/MF A01.

This report is a six-part statistical summary of surface weather observations for Alconbury RAF, Huntingdon, United Kingdom. It contains the following parts: (A) Weather Conditions; Atmospheric

Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34856 (AD-A—078351/4) **Camp Humphries AAF, Pyongtaek, Korea. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 20 Oct 1978. 425p. NTIS, PC AA18/MF A01.

This report is a six-part statistical summary of surface weather observations for Camp Humphries AAF, Pyongtaek, Korea. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34857 (AD-A—078352/2) **Plattsburgh AFB, Plattsburgh, New York. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 26 Oct 1978. 463p. NTIS, PC AA20/MF A01.

This report is a six-part statistical summary of surface weather observations for Plattsburgh AFB, Plattsburgh, New York. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34858 (AD-A—078353/0) **Lakenheath RAF, Brandon, United Kingdom. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 23 Jun 1978. 410p. NTIS, PC AA18/MF A01.

This report is a six-part statistical summary of surface weather observations for Lakenheath RAF, Brandon, United Kingdom. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34859 (AD-A—078354/8) **Yokota AB, Fussa, Japan. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 6 Oct 1978. 429p. NTIS, PC AA19/MF A01.

This report is a six-part statistical summary of surface weather observations for Yokota AB, Fussa, Japan. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34860 (AD-A—078355/5) **Volk FLD. Camp Douglas, Wisconsin. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 3 Aug 1970. 466p. NTIS, PC AA20/MF A01.

This report is a six-part statistical summary of surface weather observations for Volk FLD, Camp Douglas, Wisconsin. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34861 (AD-A—078356/3) **Hancock IAP, Syracuse, New York. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 16 May 1979. 467p. NTIS, PC AA20/MF A01.

This report is a six-part statistical summary of surface weather observations for Hancock IAP, Syracuse, New York. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34862 (AD-A—078357/1) **Duluth IAP, Minnesota. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 21 Sep 1972. 499p. NTIS, PC AA21/MF A01.

This report is a six-part statistical summary of surface weather observations for Duluth IAP, Minnesota. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

34863 (AD-A—078358/9) **Niagara Falls Map, New York. revised uniform summary of surface weather observations (RUSSWO). parts a-f. Final report.** (Air Force Environmental Technical Applications Center, Scott AFB, IL (USA)). 6 Oct 1972. 482p. NTIS, PC AA21/MF A01.

This report is a six-part statistical summary of surface weather observations for Niagara Falls MAP, New York. It contains the following parts: (A) Weather Conditions; Atmospheric Phenomena; (B) Precipitation, Snowfall and Snow Depth (daily amounts and extreme values); (C) Surface winds; (D) Ceiling Versus Visibility; Sky Cover; (E) Psychrometric Summaries (daily maximum and minimum temperatures, extreme maximum and minimum temperatures, psychrometric summary of wet-bulb temperature depression versus dry-bulb temperature, means and standard deviations of dry-bulb, wet-bulb and dew-point temperatures and relative humidity); and (F) Pressure Summary (means, standard, deviations, and observation counts of station pressure and sea-level pressure). Data in this report are presented in tabular form, in most cases in percentage

frequency of occurrence or cumulative percentage frequency of occurrence tables. (Author)

WIND ENERGY ENGINEERING

SITE CHARACTERISTICS

34864 (PNL-SA—7840) **DOE candidate site meteorological measurement program.** Renne, D.S.; Sandusky, W.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract AC06-76RL01830. 10p. (CONF-7909167—1). NTIS, PC A02/MF A01.

From IEA expert meeting; Boone, NC, USA (26 Sep 1979).

In March 1976, DOE issued an RFP to acquire, on a competitive basis, a group of candidate sites, proposed by utilities interested in the field testing program. A total of 17 candidate sites were selected from the 64 proposals submitted in response to the RFP. From these sites, five have been chosen thus far to receive turbines for field testing. This paper discusses the meteorological measurement activities at these sites and provides details of the measurement program as it exists in late 1979. In addition, the paper briefly discusses the directions this program will take in the near future, and the options interested electric service organizations have for participating in the program.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 35049

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 34684, 34685, 34686, 34687, 34688, 34689, 34690, 34691, 34692, 34693, 34694, 34695, 34696, 34697, 34698, 34699, 34700, 34701, 34702, 34703, 35034, 35052, 35053, 35096

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

34865 **Cooling with sea water.** London, England; Mechanical Engineering Publications Ltd. (1979). vp. (CONF-7905167—).

From Conference on cooling with sea water; London, UK (15 May 1979).

Separate abstracts were prepared for individual papers which were in scope. (DLC)

POWER CYCLES

REFER ALSO TO CITATION(S) 34479, 34704, 34878, 34880

WASTE-FUELED SYSTEMS

34866 (PB—80-115306) **European refuse fired energy systems: evaluation of design practices.** (Battelle Columbus Labs., OH (USA)). 1979. 2431-in 19vp. NTIS PC E99.

No abstract available.

34867 (PB—80-115355) **European refuse fired energy systems: evaluation of design practices. Volume VII. Uppsala Plant, Sweden.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 94p. NTIS, PC A05/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34868 (PB—80-115363) **European refuse fired energy systems: evaluation of design practices. Volume VIII. Zurich, Hagenholz, Switzerland.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 150p. NTIS, PC A07/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34869 (PB—80-115371) **European refuse fired energy systems: evaluation of design practices. Volume IX. Gothenburg-Savanas Plant, Sweden.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 74p. NTIS, PC A04/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34870 (PB—80-115389) **European refuse fired energy systems: evaluation of design practices. Volume X. The Hague Refuse Fired Power Plant, The Hague, Netherlands.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 74p. NTIS, PC A04/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34871 (PB—80-115405) **European refuse fired energy systems: evaluation of design practices. Volume XII. Copenhagen, Amager, Denmark.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 124p. NTIS, PC A06/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34872 (PB—80-115413) **European refuse fired energy systems: evaluation of design practice. Volume XIII. Copenhagen, West Denmark.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 167p. NTIS, PC A08/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34873 (PB—80-115439) **European refuse fired energy systems: evaluation of design practices. Volume XV. Wuppertal Refuse Fired Power Plant, Wuppertal, West Germany.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 55p. NTIS, PC A04/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34874 (PB—80-115447) **European refuse fired energy systems: evaluation of design practices. Volume XVI. Duesseldorf-Flingern Plant, West Germany.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 90p. NTIS, PC A05/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europans with waste to energy systems. The text is a compilation of the data obtaned during visits to 15 major Europan refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34875 (PB—80-115454) **European refuse fired energy systems: evaluation of design practices. Volume XVII. Baden-Brugg Plant, Turgi, Aargau, Switzerland.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 79p. NTIS, PC A05/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34876 (PB—80-115462) **European refuse fired energy systems: evaluation of design practices. Volume XVIII. Paris Issy-les Moulineaux, France.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 94p. NTIS, PC A05/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

34877 (PB—80-115470) **European refuse fired energy systems: evaluation of design practices. Volume XIX. Hamburg, Stellinger Moor, West Germany.** Engdahl, R.B.; Dartoy, J.; Beltz, P. (Battelle Columbus Labs., OH (USA)). 1979. Contract EPA-68-01-4376. 105p. NTIS, PC A06/MF A01.

The evaluation, which consists of two volumes of text and 15 trip reports, analyzes the experiences of the Europeans with waste to energy systems. The text is a compilation of the data obtained during visits to 15 major European refuse fired energy systems and visits to systems vendors, government agencies and other plants.

COMPONENTS

REFER ALSO TO CITATION(S) 34472, 35190

34878 (DOE/ET/15207—T1) **Design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. First quarterly report.** (Advanced Mechanical Technology, Inc., Newton, MA (USA)). 7 Jan 1980. Contract AC02-79ET15207. 98p. NTIS, PC A05/MF A01.

This project is Phase I of a multi-phased program for the design and development of Stirling engines for stationary power generation applications in the 500 to 3000 horsepower range. Phase I comprises the conceptual design and associated cost estimates of a stationary Stirling engine capable of being fueled by a variety of heat sources, with emphasis on coal firing, followed by the preparation of a plan for implementing the design, fabrication and testing of a demonstration engine by 1985. The main effort in Phase I is the generation of state-of-the-art conceptual designs having greatest potential for prototype testing in 1985. The conceptual designs include a heat transport system for integrating the engine heater head with such energy sources as conventional oil/gas combustors, fluidized bed and other coal combustors, and combustors using coal-derived liquid fuels, and low/medium BTU gases. The heat transport systems being investigated include forced convection with gases or liquids, heat pipes, and direct firing. Currently, the leading choice for the solid fuel combustion system is the atmospheric fluidized bed, with low BTU gasification still a viable alternative. Both systems will continue to be evaluated further, but with greater emphasis on FBC. To date, there appears no clear choice among the heat pipe, forced convection gas loop, or direct firing as the prime candidate for the heat transport sub-system. Conceptual design and analysis will continue on all three sub-systems. Scale-up of United Stirling's P-75 engine to serve as the conceptual design of the 500 HP engine module is continuing. (LCL)

34879 (EPRI-CS—1444(Vol.1)) **Air/gas system dynamics of fossil fuel power plants: Volume II. Phase 1 overview. Final report.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). Jul 1980. 81p. NTIS, PC A05/MF A01.

Combustion air/flue gas system dynamic problems in fossil fuel power plants were studied. These problems are characterized in terms of significant pressure and flow dynamic variations. These dynamic pressure variations have led to equipment and ductwork vibrations in a number of plants which have eventually resulted in ductwork and/or equipment failure. In the study, a computer-based mathematical model has been developed for the study of air/gas system dynamic problems. The model is useful for studies of basic system stability and surging as well as the response of the system to changes in damper settings and to disturbances generated by fans and other equipment. The results of the analysis have been verified with experimental field data. Methods have been developed for instrumenting plants and analyzing data to identify sources of air/gas system dynamic problems. These techniques were applied to two oil-fired, balanced-draft plants to obtain data for cold and hot operation. The data analysis identified low frequency periodic oscillations in both plants that resulted from air preheater rotation. Also pressure spectra were measured for forced-draft, induced-draft and recirculation fans and the associated ductworks. The data analysis indicated that forced-draft fans in both plants had relatively low variations in pressure amplitude and induced-draft fans had significant levels of pressure variation. The recirculation fans in both plants had high levels of pressure variation which excited recirculation duct acoustic modes. The analysis of data for one plant indicated the existence of conditions in the recirculation loop at low load levels in which a component of fan rotating-stall noise matched in frequency, and was amplified by, a duct acoustic natural mode of vibration. This pressure variation excited fan and duct structures to noticeable levels of vibration.

34880 (FE—1806-91) **Development of high-temperature turbine subsystem technology to a Technology Readiness Status, Phase II. Quarterly report, April-June 1980.** Horner, M.W. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Aug 1980. Contract AC01-76ET10340. 74p. NTIS, PC A04/MF A01.

The objective of the DOE-HTTT (High-Temperature Turbine Technology) Program is to bring to Technology Readiness, over a 6- to 10-year duration, a high-temperature gas turbine for use in a combined-cycle power plant, with coal-derived fuel, at a firing temperature of 2600°F and with growth capability to 3000°F. This program has been divided into three phases. Phase I, Program and System Definition, was completed, and Phase II commenced on August 1, 1977. The objectives of Phase II are to: (1) perform component design and technology testing in critical areas; (2) perform system design and trade-off analyses in sufficient depth to support the component design and test tasks; and (3) update the Phase I combined-cycle plant studies to evaluate the commercial viability of a GE-TRV gas turbine system. Progress in Phase II is reported.

FUELS

34881 (DOE/RG/10075—T1) **Coal conversion engineering analysis for Central Hudson Gas and Electric Corporation, Danskammer Generating Station, Units 3 and 4. Final report.** (AMAF Industries, Inc., Columbia, MD (USA)). 1980. Contract AC01-79RG10075. 40p. NTIS, PC A03/MF A01.

The technical and economic feasibility of converting the Danskammer Power Plant at Roseton, NY from oil- to coal-firing was examined. This plant, built in 1950, was converted from coal- to oil-firing in 1971. Evaluation of the plant showed that oil-to-coal conversion is technically feasible, but modifications or additions to existing plant equipment would be required to meet coal handling needs and pollution control regulations. With no flue gas desulfurization equipment the 1980 cost of plant reconversion is estimated as $50.3 million. A FGD system would require an additional $40 million in direct costs. The total time estimated for engineering, construction, and licensing is 57 months. (LCL)

34882 **COMs: boiler fuel of the future?.** Pruce, L.M. *Power (N.Y.);* **124**: No. 2, 108-110(Feb 1980).

The results of the discussions at the second International Symposium on Coal/Oil Mixture (COM) Combustion, sponsored by DOE and coordinated by the Pittsburgh Energy Technology Center (PETC) are presented. Experience shows that COMs, when burned, exhibit properties similar to those of residual fuel oil. The most important DOE-sponsored demonstration project now under way is at New England Power Service Co's Salem Harbor generating station. The test boiler at Salem Harbor is a 625,000 lb/hr steam generator serving the station's 80-MW unit. Probably the most promising result to date has been the appearance of short, bright burner flames when using a 20% coal mixture, indicating good combustion.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 35384, 35385, 35386, 35429, 35456, 35457, 35472

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 35416

34883 (DOE/ET/10373—07) **Granular Bed Filter Development Program, Phase II. Monthly technical progress report for April 1-30, 1980.** Moresco, L.L.; Cooper, J.; Ferguson, J. (Combustion Power Co., Inc., Menlo Park, CA (USA)). 1980. Contract AC21-77ET10373. 19p. NTIS, PC A02/MF A01.

The Department of Energy is sponsoring a multiphase program to investigate the filtration potential of the moving bed granular filter (GBF) for application in pressurized high temperature energy conversion systems. Phase I included the development of a mathematical model, a cold flow parametric test series in a 0.746 Nm^3/s GBF, and investigations of potential dust plugging problems at the inlet screen. During the experimental program, collection efficiencies of 99% and filter outlet loadings less that 0.0074 g/m^3 were demonstrated. The objectives of Phase II are to investigate the effects of elevated temperature and coal combustion particulate on GBF filtration performance, to update the analytical model developed in Phase I to reflect high-temperature effects, to optimize filter internal configuration, to demonstrate long duration GBF performance relative to corrosion, deposition, erosion, filtration efficiency, reliability, controllability, and to design and construct a 0.879 Nm^3/s, 660 kPa filter for delivery to DOE. Hot flow testing to date has confirmed that the GBF configured with inlet and outlet screens has exhibited a tendency for extensive and irreversible ash plugging. As an alternative, the potential advantages produced by a screenless configuration, having higher filtration efficiency, has been achieved during both cold flow and hot flow tests as previously reported. Feed and solid compositions from test P704, the 400-hour GBF test, are presented. A status report on the design of the high pressure GBF along with operation details for purging the GBF of corrosive gases upon shutdown and granular reserve sensing during its operation are detailed.

34884 (DOE/RA/02709—T1) **Investigation of high velocity separator for particle removal in coal gasification plants. Phase II report.** Linhardt, H.D. (Linhardt and Associates, Inc., Newport Beach, CA (USA)). 15 Jan 1980. Contract EF-77-C-01-2709. 90p. NTIS, PC A05/MF A01.

This report summarizes the results of Phase II of the High Velocity Particle Separator Program performed under Contract EF-77-C-01-2709. This high velocity wedge separator has the potential to reduce equipment size and cost of high temperature and pressurized particulate removal equipment for coal derived gases. Phase II has been directed toward testing and detailed conceptual design of an element suitable for a commercial scale high temperature, high pressure particle separator (HTPS). Concurrently, Phase IA has been conducted, which utilized the ambient analog method (AAM) for aerodynamic and collection performance investigation of each HTPS configuration prior and during hot testing. This report summarizes the results of Phase IA and II. The AAM effort established correlation of theoretical analysis and experiment for HTPS pressure drop, purge flow ratio and collection efficiency potential. Task I defined the initial test conditions to be the contract design point of 1800°F and 350 psia. The 1800°F, 350 psia testing represents the main high temperature testing with coal-derived particulates in the 2 to 10 micron range. Phase IA and Phase II have demonstrated efficient particle collection with acceptable pressure drop. In view of these encouraging results, it is reasonable to apply the developed technology toward future hot gas particulate cleanup requirements.

34885 (PB—80-112774) **Air quality impact of converting the C.P. Crane Power Plant to higher sulfur content fuels. Appendices.** Brower, R. (Martin Marietta Corp., Baltimore, MD (USA). Environmental Center). Oct 1979. 166p. NTIS, PC A08/MF A01.

34886 (PB—80-112808) **Air quality impact of converting the C.P. Crane Power Plant to higher sulfur content fuels. Final report.** Brower, R. (Martin Marietta Corp., Baltimore, MD (USA). Environmental Center). Oct 1979. 103p. NTIS, PC A06/MF A01.

The air quality effects of converting the Crane Power Plant from burning 1% sulfur oil to 2.3% sulfur coal have been calculated using three approaches to stability description. Compliance with PSD increment and effect on a particulate non-attainment area are also considered. The plant is found to comply with all appropriate air quality regulations under the proposed conversion.

SITE SELECTION AND LAND USE

34887 (PB—80-116908) **Utah coal for southern California energy consumption.** Grew, P.C.; Simmons, M.; Sokolow, B. (California Univ., Los Angeles (USA). Office of Environmental Science and Engineering). 1976. 329p. NTIS, PC A15/MF A01.

This study results from the need of Southern California to receive a large part of its electrical energy from coal-fired power plants located outside of the state. The dependence on coal arises from arrangements made by the electrical utilities of Southern California with officials of the Federal government and of states other than California. Of particular importance is the planned construction of one or two 3,000 megawatt mine-mouth coal-fired electric power plants in Utah from which the majority of electrical power produced would flow to Southern California. Establishment of such plants for this purpose raises a number of unresolved problems. This report addresses each of these issues which are reduced to four major classes arising from: (1) use of Upper Colorado River Basin surface water in the production of energy; (2) degradation of air quality in the area where the plants are sited; (3) choices for the mode of transportation of energy from the producer region to the consumer region; and (4) the socioeconomic impact on the producer region. A proposed Kaiparowits Project, in which a coal region in southern Utah would be used to provide energy for Southern California is described in detail.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 34631

34888 (ANL/ES—92) **Laser satellite power systems.** Walbridge, E.W. (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 84p. NTIS, PC A05/MF A01.

A laser satellite power system (SPS) converts solar power captured by earth-orbiting satellites into electrical power on the earth's surface, the satellite-to-ground transmission of power being effected by laser beam. The laser SPS may be an alternative to the microwave SPS. Microwaves easily penetrate clouds while laser radiation does not. Although there is this major disadvantage to a laser SPS, that system has four important advantages over the microwave alternative: (1) land requirements are much less, (2) radiation levels are low outside the laser ground stations, (3) laser beam sidelobes are not expected to interfere with electromagnetic systems, and (4) the laser system lends itself to small-scale demonstration. After describing lasers and how they work, the report discusses the five lasers that are candidates for application in a laser SPS: electric discharge lasers, direct and indirect solar pumped lasers, free electron lasers, and closed-cycle chemical lasers. The Lockheed laser SPS is examined in some detail. To determine whether a laser SPS will be worthy of future deployment, its capabilities need to be better understood and its attractiveness relative to other electric power options better assessed. First priority should be given to potential program stoppers, e.g., beam attenuation by clouds. If investigation shows these potential program stoppers to be resolvable, further research should investigate lasers that are particularly promising for SPS application.

34889 (PB—80-103393) **Optimization of power system security and saving. Summary report.** El-Abiad, A.H. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). Aug 1972. 12p. NTIS, PC A02/MF A01.

Research on the development of sophisticated methods to ensure high reliability of electric power systems is reported. Increasing incidence of critical and emergency operating conditions necessitates improved operating criteria and procedures (security control) in addition to planning criteria and improved design and systems designs. The area of optimization was studied to determine the optimum combination of system generating parameters. A generalized nonlinear algorithm programming approach was developed as the essential part of control strategy. This concept overcomes two major difficulties, viz, handling functional inequality constraints, and providing fast convergence. Efforts also were made to improve solutions of closely related problems, such as solution of the optimal schedule of an integrated hydro-thermal power system, units commitment, and spinning reserve. Also, an investigation was initiated concerning the difficult and ill-defined subject of system results which involves proper integration of controls to maintain electric power service under all operating conditions. A list of publications resulting from the research grant and the manner of disseminating the research results are included.

34890 (TR-EE—78-10) **Optimization of cable systems subject to stochastic loading.** Viviani, G.L; Heydt, G.T. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). Feb 1978. 73p. (PCTR—57-78). Purdue Univ., Lafayette, IN.

Those aspects of automated or computer-aided cable design which are pertinent to the optimization of the performance and economics of underground power transmission cables are discussed. This study concluded that it is possible to optimally design an electric energy cable using a computer algorithm. The formulation of the index of performance is relegated to engineering judgement. The optimization procedure described is a gradient method. The load current can be modeled as a stochastic process. Utilization of a stochastic model yields more realistic analysis of the cable. A useful design tool, unit cost, has been introduced. For a problem in which exact costs are difficult to formulate, this provides a method to compare alternate designs. The design procedure has incorporated the effects of inequality constraints. A signal conclusion relates to cost reduction: cost reductions are comensurate with more efficient design. A realistic 1/0 cable design, with increased current carrying capability at the same cost is evidence of the more efficient design.

DC SYSTEMS

34891 (AD-A—078627/7) **A new approach to the design of highly efficient regulated dc-to-dc converters. Technical memo.** Cowett, P.M. Jr. (Harry Diamond Labs., Washington, DC (USA)). Oct 1979. 17p. NTIS, PC AA02/MF A01.

This report describes a novel approach to the design of efficient switching regulated dc-to-dc converters whereby an energy storage inductor and a commutating diode are in the output transformer primary circuit of the converter. This design has advantages of simplicity, economy, reliability in applications where high-output voltages, multiple-output voltages, or both are involved.

34892 (PNL-SA—7520) **Field determinations of HVdc ozone production rates.** Droppo, J.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. Contract AC06-76RL01830. 17p. (CONF-7904144—1). NTIS, PC A02/MF A01.

From Summer meeting of the Institute of Electrical and Electronics Engineers; New York, NY, USA (24 Apr 1980).

The environment near a high voltage direct current (HVdc) transmission line experiences corona effects, including the production of oxidants. Field determination of ozone production rates were made at the Bonneville Power Administration (BPA) HVdc Test Facility, the Dalles, Oregon, in fall and winter 1977. A novel micrometeorological profiling technique was used to identify sources of ozone plumes. The results indicate that even during precipitation the atmospheric ozone concentrations from HVdc lines at voltages up to +550 kV are relatively small. Measured atmospheric ozone concentration plumes are consistent with laboratory data predictions of ozone concentrations based on corona, line parameters, and

ambient dispersion. This confirmation under worst-case field conditions demonstrates the validity of previous estimates of a very low magnitude of the potential ozone effects.

NUCLEAR POWER PLANTS

34893 (DOE/NE—0030/2(80)) **US Central Station Nuclear Electric Generating Units: significant milestones. (Status as of April 1, 1980).** (Department of Energy, Washington, DC (USA). Office of Nuclear Reactor Programs). Jun 1980. 43p. NTIS, PC A03/MF A01.

Construction and operational milestones are tabulated for US nuclear power plants. Data are presented on nuclear steam supply system orders. A schedule of commercial operation through 1990 is given.

34894 **Nuclear power: option for the world.** Essen, Germany; Vulkan-Verlag (1979). 487p. (In several languages). (CONF-790519—).

From European nuclear conference; Hamburg, F.R. Germany (6 May 1979).

Information is presented concerning reactor systems; nuclear fuel cycle; reactor licensing; nuclear power and the public; education and training; economics, financing, and insurance; safeguards and physical protection; international cooperation; technology transfer; nuclear power in developing countries; energy strategies; and fusion.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 34939, 34948, 34949, 34950, 34951, 34952, 34954, 34957, 34959, 34964, 34966, 34968, 34969, 34971, 34973, 34974, 34975, 34976, 34978, 34982

34895 (CONF-800403—(Vol.1), pp 102-109) **Reliability of fire protection systems in nuclear power plants.** Moelling, D.S. (Combustion Engineering Inc., Windsor, CT); Sideris, A.G.; Hockenbury, R.W. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Selected water sprinkler fire protection systems from four nuclear power plants were evaluated using standard fault-free analysis methods. The objecitve was to find the most important components, the sensitivity to failure rates and test intervals, and to assess the total system reliability. If adequate supervision of those valves, which if closed cut off flow to the sprinkler heads, is achieved it should be possible to limit the probability of failure for sprinkler systems to less than 10^{-2} per demand compared to industrial failure experience of approximately 2×10^{-2} per demand. A methodology was developed to estimate the probability of a specific fire to cause the fire protection system to actuate.

34896 (CONF-800403—(Vol.1), pp 524-531) **Study of valve failures which impact the safety and operation of light water nuclear power plants.** Tsacoyeanes, J.C.; Raju, P.P. (Teledyne Engineering Services, Waltham, MA). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

This paper presents the results of a pilot program initiated by Sandia Laboratories under the Department of Energy, Light Water Reactor Safety Research and Development Program. The program was conceived as a result of earlier LWR safety and reliability studies which indicated that a substantial number of plant trip incidents were caused by failure of system components such as valves. The specific objectives of this program are: (1) to identify the principal types and causes of failures in valves, valve operators and their controls and associated hardware, which lead to, or could lead to plant trip, and; (2) to suggest possible remedies for the prevention of these failures and recommend future research and development programs which could lead to reducing these valve failures or to mitigating their effect on plant operation. The data surveyed covers incidents reported over the six-year period, beginning 1973 through the end of 1978. Three sources of information on valve failures have been consulted: (1) failure data centers, (2) participating organizations in the nuclear power industry, and (3) technical documents.

34897 (CONF-800403—(Vol.2), pp 802-810) **J-integral plastic fracture mechanics evaluation of stability of cracks in RPV.** Gomez, M.P. (Washington, Univ., St. Louis, MO); Parks, D.; McMeeking, R.; Jackson, J. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The analysis of the stability of cracks in RPV using J-integral fracture mechanics concepts is discussed. An outline of a proposed methodology based on comparing the loading parameters J/sub APP/ and dJ/sub APP//da with the material resistance parameters J/sub MAT/ and dJ/sub MAT//da is presented. Two methods to compute J/sub APP/ and dJ/sub APP//da are analyzed. One of them, based on the line-spring model proposed by Rice, was developed for analyses using elastic-perfectly plastic material behavior. Results for two families of cracks in 228.6 mm thick flat plates are presented for a steel with a 490 MPa yield strength, for a range of crack depths between 68.6 and 182.9 mm and applied stress between 0.2 and 0.9 σy. Results obtained using both methods show remarkable agreement. Some J/sup APP/ values for cylindrical shells of radius equal to 2.286 m and thickness t = 228.6 mm are also shown and compared with flat plate results using the same methods, and with shell and flat plate results using simpler models.

34898 (CONF-800403—(Vol.2), pp 819-826) **Research needs for resolving the significant problems of Light Water Reactor piping systems.** Kustu, O.; Scholl, R.E. (URS/John A. Blume and Associates, San Francisco, Ca). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Past surveys of Light Water Reactor (LWR) piping system problems and recent Licensee Event Report (LER) summaries are studied to identify the significant problems of LWR piping systems and their primary causes. Pipe cracking is identified as the most recurring problem. The most significant cause of pipe cracking, and of other piping system problems in general, is determined to be the vibration of pipes due to operating pump-pipe resonance, fluid-flow fluctuations, and vibration of pipe supports. Recent, ongoing, and planned research in the United States relevant to the identified piping system problems is evaluated, and, on this basis, the need for further research toward resolving these problems is determined. Programs to carry out needed research are suggested on topics related to pipe vibration, thermal and dynamic pipe behavior, piping analysis, fatigue, design loads, and the problem of radiation buildup in corrosion products.

34899 (CONF-800403—(Vol.2), pp 838-844) **Assessment of current Light Water Reactor piping design loadings based on operating experience.** Snyder, T.K.; Svensson, P.O. (EDS Nuclear Inc., San Francisco, CA). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

This paper will describe the results of a study which is being performed to assess the validity of current LWR piping design practices with specific regard to the specification of loadings. A comparison is made of current design loadings and loadings which have been experienced in operation. The sources of design loadings are currently accepted industry loadings as reflected in LWR Safety Analysis Reports and a limited survey of NSSS/A-E efforts relative to recently recognized loadings. The basis for operational loadings are actual field measured and observed responses for existing LWR piping systems under a full range of operating conditions.

34900 (DOE/CEA/BMFT—2) **Rupture probability of a nuclear reactor pressure vessel. Sixth progress report, 15 September 1978-15 March 1979. Report DSN No. 281.** Dufresne, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1979. 90p. (In French). NTIS (US Sales Only), PC A05/MF A01.

Rupture criteria required to evaluate the rupture probability of a pressure vessel concern both the ductile and the brittle failure. A single criteria including both failure type, and proposed by Dowling and Townley could be used. Validation of this criterion using experimental results shows that it is significant when the external to internal diameter ratio does not exceed 1.2. Stress analysis in nozzles has been computed for 20 transients. Equivalent stress and principal stress were determined for 12 intervals of time during each transient. Analytical methods, adopted to compute stress intensity factor, have been validated using a precise computing method that uses a polynomial function of influence. Tests of fatigue crack growth in mixed mod I + II have shown that the branching was due to the stress field and not to the equipment used. Sizing and distribution of defects in LWR nuclear pressure vessel welds, have been defined using data from 3 European manufacturers. The experimental program on fatigue crack growth of natural defects is presently under way.

34901 (DP-MS—80-24) **Economics of spent LWR fuel storage.** Clark, H.J.; O'Neill, G.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 6p. (CONF-800901—1). NTIS, PC A02/MF A01.

From Symposium on intermediate range atmospheric transport processes and technology assessment; Gatlinburg, TN, USA (29 Sep 1980).

A power reactor operator, confronted with rising spent fuel inventories that would soon exceed his storage capacity, has to

decide what to do with this fuel if he wants to continue reactor operations. A low cost option would be to ship excess fuel from the overburdened reactor to another reactor in the utility's system that has available space. The only cost would be for cask leasing and shipping. Three other alternatives all require considerable capital expenditures: reracking, new at-reactor (AR) basins for storage, and away-from-reactor (AFR) basins for storage. Economic considerations for each of the alternatives are compared.

34902 (UCRL—15215) **Seismic Safety Margins Research Program. Phase 1. Project V. Structural sub-system response: subsystem response review.** Fogelquist, J.; Kaul, M.K.; Koppe, R.; Tagart, S.W. Jr.; Thailer, H.; Uffer, R. (Nuclear Services Corp., Campbell, CA (USA)). Mar 1980. Contract W-7405-ENG-48. 107p. NTIS, PC A06/MF A01.

This project is directed toward a portion of the Seismic Safety Margins Research Program which includes one link in the seismic methodology chain. The link addressed here is the structural subsystem dynamic response which consists of those components and systems whose behavior is often determined decoupled from the major structural response. Typically the mathematical model utilized for the major structural response will include only the mass effects of the subsystem and the main model is used to produce the support motion inputs for subsystem seismic qualification. The main questions addressed in this report have to do with the seismic response uncertainty of safety-related components or equipment whose seismic qualification is performed by (a) analysis, (b) tests, or (c) combinations of analysis and tests, and where the seismic input is assumed to have no uncertainty.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 34895, 34896, 34897, 34898, 34899, 34900, 34901, 34902, 34912, 34934, 34948, 34949, 34950, 34951, 34952, 34953, 34954, 34955, 34956, 34957, 34958, 34959, 34961, 34962, 34963, 34964, 34965, 34966, 34968, 34969, 34970, 34971, 34972, 34973, 34974, 34975, 34976, 34977, 34978, 34979, 34980, 34981, 34982, 34987, 34990

34903 **PWR steam generator tubing. Corrosion problems.** Van Rooyen, D. (Brookhaven National Lab., Upton, NY (USA)). pp 217-233 of Reliability problems of reactor pressure componetns. Vienna; International Atomic Energy Authority (1978).

From Symposium on application of reliability techniques to nuclear power plants; Vienna, Austria (10 Oct 1977).

The corrosion problems that have been experienced with tubing in recirculating steam generators are summarized, indicating the extent to which phosphate wastage, caustic cracking, fatigue, denting, and primary side stress corrosion cracking have contributed to tube degradation in operating plants. Observations of the two most widespread types of attack, i.e. phosphate wastage and denting, are described in detail. Wastage seems to be consistent with a mechanism in which solid sodium ortho-phosphate is deposited on the Inconel tubes, followed by conversion to highly corrosive pyrophosphate. Reasons for differences between laboratory results and the rates of wastage found in service are discussed. Denting is ascribed to the formation of an acid chloride environment in tube support plate crevices, which attacks the carbon steel and produces non-protective, bulky magnetite, leading to deformation of tubes and support plates. Impurities from condenser leaks, corrosion products from steel, Inconel, or copper base alloys and phosphates may trigger or accelerate denting; improved condenser performance and/or demineralization are needed to prevent problems caused by contamination of the secondary water. Severe denting has led to intergranular stress corrosion cracking of Inconel 600 in primary water, and deformation and cracking of the support plates. It is believed that the cracking in Inconel occurs in primary water according to predictions made many years ago, and that hydrogen is a likely cause of cracking in the highly deformed steel. A few alternate materials for steam generator tubing are mentioned together with some of their properties.

34904 (CONF-800403—(Vol.1), pp 177-188) **Development and analysis of vent-filtered containment conceptual designs.** Benjamin, A.S.; Walling, H.C. (Sandia National Labs., Albuquerque, NM). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Conceptual filtered-vented containment systems have been postulated for a reference large, dry, pressurized water reactor containment, and the systems have been analyzed to determine design parameters, actuation/operation requirements, and overall feasibility. The primary design challenge has been found to emanate from pressure spikes caused by core debris bed interactions with water and by hydrogen deflagrations. Circumvention of the pressure spikes may require a more complicated actuation logic than has previously been considered. Otherwise, major reductions in consequences for certain severe accidents appear to be possible with relatively simple systems. A probabilistic assessment of competing risks remains to be performed.

34905 (CONF-800403—(Vol.2), pp 1110-1117) **Diagnostics at TMI using noise analysis.** Robinson, J.C. (Technology for Energy Corp., Knoxville, TN); Fry, D.N. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Noise analysis was used at Three Mile Island Unit 2 Nuclear Power Plant following the March 28, 1979, accident to assess the health of sensors, assure the absence of violent boiling, predict sensor failure, and others. The pressure noise from the primary pressure sensors located in the A and B loop is studied. The primary objective in using pressure noise was as a degasification meter. From cross correlation analysis between the A and B loop pressure sensors, it was determined: (1) the core barrel was still basically intact and moving in its normal pendulum mode; (2) there was not a large gas bubble located in the B loop; (3) both pressure sensors were in good health; and (4) the pressure noise was being driven by the reactor coolant pump which was exciting hydraulic resonances. When gas came out of solution, the hydraulic resonances (hence noise) were dampened. Therefore, the pressure noise was used as a degasification indicator from which operators were guided through the degasification process.

34906 (CONF-800765—1) **Barium silicate glass/Inconel X-750 interaction.** Kelsey, P.V. Jr.; Siegel, W.T.; Miley, D.V. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 11p. NTIS, PC A02/MF A01.

From 7. LLR/MMRD international symposium of interfaces in glass-metal systems; Berkeley, CA, USA (28 Jul 1980).

Water reactor safety programs at the Idaho National Engineering Laboratory have required the development of specialized instrumentation. An example is the electrical conductivity-sensitive liquid level transducer developed for use in pressurized-water reactors (PWRs) in which the operation of the sensing probe relies upon the passage of current through the water between the center pin of the electrode and its shell such that when water is present the resulting voltage is low, and conversely, when water is absent the voltage is high. The transducer's ceramic seal is a hot-pressed glass ceramic; its metal housing is Inconel X-750. The ceramic material provides an essential dielectric barrier between the center pin and the outer housing. The operation of the probe as well as the integrity of the PWR environment requires a hermetically-bonded seal between the ceramic and the metal. However, during testing, an increasing number of probe assemblies failed owing to poor glass-to-metal seals as well as void formation within the ceramic. Therefore, a program was initiated to characterize the metallic surface with respect to pre-oxidation treatment and determine optimum conditions for wetting and bonding of the metal by the glass to obtain baseline data relevant to production of acceptable transducer seals.

34907 (CONF-800802—13) **Flowsheet development studies for the decontamination of high-activity-level water at Three Mile Island Unit 2.** Collins, E.D.; Bigelow, J.E.; Campbell, D.O.; King, L.J.; Knauer, J.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Several chemical processing flowsheets were considered for the decontamination of high-activity-level water at the Three Mile Island (TMI) Unit 2. A zeolite ion exchange process was evaluated and recommended for absorption of the bulk of the highly radioactive cesium and strontium. Standard organic ion-exchange resins were selected to remove the remaining traces of radioactive nuclides (except tritium which cannot be removed by any practical process). Process conditions were evaluated using both synthetic, tracer-level solutions and samples of actual, high-activity level water from TMI Unit 2.

34908 (UCRL—84155) **Seismic review of the R.E. Ginna Nuclear Power Plant as part of the Systematic Evaluation Program for the Nuclear Regulatory Commission.** Murray, R.C.; Nelson, T.A.; Ng, D.S.; Liaw, C.Y.; Levin, H.A.; Cheng, T.M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; EG and G, Inc., San Ramon, CA (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 27 May 1980. Contract W-7405-ENG-48. 23p. (CONF-800904—1). NTIS, PC A02/MF A01.

From American Society of Civil Engineers specialty conference: civil engineering and nuclear power; Knoxville, TN, USA (15 Sep 1980).

This paper is a progress report on work at the Lawrence Livermore National Laboratory (LLNL) to perform a limited seismic reassessment of the Robert E. Ginna Nuclear Power Plant. The reassessment is being done for the Nuclear Regulatory Commission

(NRC) as part of the Systematic Evaluation Program. The reassessment focuses generally on the reactor coolant pressure boundary and on those systems and components necessary to shut down the reactor safely and to maintain it in a safe shutdown condition following a postulated earthquake characterized by a peak horizontal ground acceleration of 0.2 g. Methods and modeling procedures used to analyze a complex of interconnected buildings are highlighted.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 34935, 34983, 34984, 34985, 34986, 34989, 34993

34909 (ORNL—5597) **Carbon-14 production in the Peach Bottom HTGR core.** Wichner, R.P.; Dyer, F.F. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 71p. NTIS, PC A04/MF A01.

Carbon-14 concentrations were measured in a variety of core components during the Peach Bottom Surveillance Program. Five fuel element sleeves and spines were dissected to obtain radial concentration profiles at four axial locations. The profiles show that the major part of the ^{14}C in these graphite components characteristically showed a flat radial distribution across the interior of the member; the balance was found in concentration peaks at each exposed surface. The source of these surface peaks is not fully understood. Concentrations were also determined in five fuel element fission product traps, one removable radial reflector block, and 12 fuel particle pairs taken from a number of axial locations in one fuel element. Estimates of whole-core inventory were made from these concentration determinations.

34910 (ORNL/TM—7393) **Interaction of silver and palladium with silicon carbide in HTGR fuel particles. Preliminary report.** Lauf, R.J. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

Fuel particles for the High-Temperature Gas-Cooled Reactor contained a layer of pyrolytic silicon carbide, which acts as a pressure vessel and provides containment for metallic fission products. The SiC layer is deposited by the thermal decomposition of methyltrichlorosilane (CH_3SiCl_3 or MTS) in an excess of hydrogen. Certain fission products, notably silver and palladium, can cause degradation of the SiC during irradiation. The purpose of this study is to develop a quantitative data base to better understand noble-metal attack as well as to evaluate the relationship between SiC deposition conditions and noble-metal release. The interaction between SiC and noble-metal fission product elements was investigated in the temperature range 1200 to 1500°C.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 34934

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 34612, 34928, 34929, 34930, 34931, 34932, 34934, 34947, 34988, 34991, 34995, 35196

34911 (ANL—80-40, pp 337-358) **Part 8. Deployment considerations.** Dance, K.D.; Chang, Y.I.; Daly, T.A. Jul 1980.

In Fast Breeder Reactor studies.

This report addresses considerations of fast breeder reactor development and deployment from a national perspective. Nations vary greatly in their expertise and interest relative to nuclear power, and hence a single set of steps to be taken by a nation in decision-making on breeder development and deployment cannot be presented. The approach taken in this report is to present discussions on key factors influencing the breeder development and deployment decisions, especially in non-breeder nations, by drawing upon historical perspectives of the Light Water Reactor for comparison.

34912 (ANL—80-40, pp 359-408) **Annex. Decommissioning of a large central-station LMFBR power plant: a comparison with the PWR.** Amorosi, A.; Honekamp, J.R.; Monson, H.O. Jul 1980.

In Fast Breeder Reactor studies.

The decommissioning of a liquid metal fast breeder reactor (LMFBR) is qualitatively compared with that of a more conventional pressurized water reactor (PWR). The PWR and LMFBR are examined for differences which might impact the total station decommissioning costs, and the primary systems of both reactor types are compared to determine if design differences in their radioactive portions would substantially alter the overall balance of costs evaluated in earlier comparative studies of decommissioning alternatives. Consideration of the ease of disassembly, relative quantities of structural material to be treated, and the special aspects related to the sodium coolant indicated that, for otherwise equivalent circumstances, dismantling operations are of corresponding difficulty, decommissioning costs are comparable, and, if the primary sodium is reused in another reactor and proper credit taken, the sodium coolant does not add to the cost of decommissioning.

34913 (CONF-800942—1) **CRBRP reactor system shield design and impact of new materials irradiation damage data.** Wrights, G.N. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Jan 1980. Contract AC15-76CL02395. 7p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

Structural materials radiation damage data have received considerable attention in the design of LMFBR permanent reactor structures. A recent FFTF/CRBRP structural materials irradiation experiment, conducted as part of the national program plan for irradiation effects on mechanical properties of LMFBR out-of-core structural materials, has found engineering application in setting energy-dependent neutron exposure limits of irradiated structures. This paper describes the impact of the new irradiated materials data on the CRBRP in-vessel shield design and material selection.

34914 (DOE/ET/37240—75) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Progress report, December 1, 1979-February 29, 1980.** Todreas, N.E.; Golay, M.W.; Wolf, L. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1980. Contract AS02-76ET37240. 60p. NTIS, PC A04/MF A01.

Information is presented concerning bundle geometry with wrapped and bare rods; LMFBR outlet plenum flow mixing; and theoretical determination of local temperature fields in LMFBR fuel rod bundles.

34915 (DOE/ET/37241—43) **MIT LMFBR blanket research project. Quarterly progress report, April 1-June 30, 1980.** Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 11 Aug 1980. Contract AS02-76ET37241. 9p. NTIS, PC A02/MF A01.

Information is presented concerning benchmark calculations for reactivity coefficients; and neutronic characteristics for heterogeneous assemblies and breed-burn cores.

34916 (GA-A—15732) **Gas-cooled fast breeder reactor. Quarterly progress report, November 1, 1979 through January 31, 1980.** (General Atomic Co., San Diego, CA (USA)). Feb 1980. Contract AT03-76SF71023. 259p. NTIS, PC A12/MF A01.

Information is presented concerning the nuclear steam supply system; reactor core; systems engineering; safety and reliability; and circulator test facility.

34917 (GA-A—15909) **GCFR core thermal-hydralic design.** Schleuter, G.; Baxi, C.B.; Bennett, F.O. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 27p. (CONF-800648—18). NTIS, PC A03/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

The approach for developing the thermal-hydraulic core assembly designs for the gas-cooled fast reactor (GCFR) is reviewed, and key considerations for improving the core performance at all power and flow conditions are discussed. It is shown how the thermal-hydraulic core assembly designs evolve from evaluations of plant size, material limitations, safety criteria, and structural performance considerations.

34918 (GA-A—15919) **Fabrication development of full-sized components for GCFR core assemblies.** Lindgren, J.R.; Flynn, P.W.; Foster, L.C. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF71023. 31p. (CONF-800648—19). NTIS, PC A03/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

This paper presents the status of the development of full-sized components for gas-cooled fast reactor (GCFR) core assemblies. Methods for ribbing of the fuel rod cladding, fabrication of grid spacers of two different designs, drawing of assembly flow ducts, and fabrication of fission gas collection manifolds by several methods are discussed.

34919 (GEFR-SP—221) **Water chemistry of breeder reactor steam generators.** Simpson, J.L.; Robles, M.N.; Spalaris, C.N.; Moss, S.A. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Aug 1980. Contract AT03-76SF70030. 30p. (CONF-801036—3). NTIS, PC A03/MF A01.

From Special topical meeting - materials performance in nuclear steam generators; St Petersburg Beach, FL, USA (6 Oct 1980).

The water quality requirements will be described for breeder reactor steam generators, as well as specifications for balance of plant protection. Water chemistry details will be discussed for the following power plant conditions: feedwater and recirculation water at above and below 5% plant power, refueling or standby, makeup water, and wet layup. Experimental data will be presented from tests which included a departure from nucleate boiling experiment, the Few Tube Test, with a seven tube evaporator and three tube superheater, and a verification of control and on-line measurement of sodium ion in the ppB range. Sampling and instrumentation requirements to insure adherence to the specified water quality will be described. Evaporator cleaning criteria and data from laboratory testing of chemical cleaning solutions with emphasis on flow, chemical composition, and temperature will be discussed.

34920 (HEDL-SA—2011-FP) **Postirradiation cladding strength under biaxial loading with an increasing temperature ramp.** Duncan, D.R.; Hunter, C.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1980. Contract AC14-76FF02170. 13p. (CONF-800609—11). NTIS, PC A02/MF A01.

From 10. international symposium on effects of radiation on materials; Savannah, GA, USA (3 Jun 1980).

The flow behavior of unirradiated 20% cold worked AISI 316 tubing during constant pressure, increasing temperature tests was modeled with a constitutive relation approach; strain below approximately 0.2% came predominantly from an anelastic portion of the model while higher strains were predominantly plastic. The flow of cladding sections from irradiated fuel pins was largely restricted to the strain region attributed to anelastic deformation due to reduced ductility compared to unirradiated tubing. Another major effect of irradiation exposure on cladding flow was softening, or increased strain, found with increasing irradiation temperature. This was noted only when test pressures were high enough to cause flow below 950°K.

34921 (ORNL/TM—7418) **Determination of coefficients for the universal laws of friction and heat transfer for CFTL calculations.** Hodge, S.A. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01.

The friction factor and Stanton number for flow past a roughened surface are determined by the parameters A and $R(h^+)$ of the universal law of friction and A/sub H/ and $G(h^+)$ of the universal law of heat transfer. The methods to be used for determination of these parameters for the particular roughness to be used in the Core Flow Test Loop (CFTL) are presented. Examples are given concerning the application of these methods to both transitional and fully rough flow using experimental results taken from the literature.

34922 **Pressure transient analysis in piping systems including the effects of plastic deformation and cavitation.** Youngdahl, C.K.; Kot, C.A.; Valentin, R.A. (Argonne Natl Lab, Ill). *J. Pressure Vessel Technol.;* **102**: No. 1, 49-55(Feb 1980).

NONE

34923 **Internal bore welding of 2/one quarter/Cr-1 Mo steel tube-to-tubesheet joints.** Moorhead, A.J.; Reed, R.W. (Oak Ridge Natl Lab, Tenn). *Weld. J. (Miami);* **59**: No. 1, 26-37(Jan 1980).

The most critical weldments in the steam supply system for a liquid metal fast breeder reactor are those that join the steam generator tubes to the tube-sheets. A modified internal welding tip with a Ta 10% W collet as well as a fused quartz gas cup was used. The pressure differential between the inside and outside of tubular welds (determined with a water manometer) is critical in controlling weld bead geometry. 8 refs.

34924 **Formulation and application of a three-dimensional structural model for upper internal structures.** Kennedy, J.M. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.); Belytschko, T.B. (Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering). *Nucl. Eng. Des.;* **55**: No. 2, 173-184(Dec 1979).

From 5. international conference on structural mechanics in reactor technology (SMIRT-5) and 9. international seminar in conjunction with 2. international seminar on structural reliability of mechanical components and subassemblies of nuclear power plants and 2. international seminar on containment of fast breeder reactors; Berlin, Germany, F.R. (9 - 21 Aug 1979).

A finite element structural model is developed for the upper internals which is capable of treating material nonlinearities and geometric nonlinearities arising from large displacements when subjected to dynamic loads. This structural model can be used either by itself or in a interactive mode with a hydrodynamics code. The upper internal structure (UIS) is essentially a massive, perforated rigid body is connected to the reactor head by support columns with a cylindrical cross section. The major response of interest is the buckling of these support columns which results from the compressive forces they sustain when the upper internals are loaded vertically upward by dynamic loads. For the case of substantial change in the shape of the column cross section, it will be more convenient to treat the behaviour of the elements stiffness in terms of moment-curvature relations which account for the changes in flexural rigidity with change in cross section. Two factors considered of importance in developing the model are: (1) whether an imperfection is necessary in the initial mesh of the columns to trigger buckling and to what extent does the magnitude of the imperfection effect the results; (2) whether the buckling pattern is symmetric or asymmetric. It was established by these studies that elastic buckling is not affected by the magnitude of the imperfection; for plastic buckling, the results are more sensitive to the magnitude.

34925 **Analysis of primary containment response with upper internal structure.** Wang, C.Y.; Chu, H.Y. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nucl. Eng. Des.;* **55**: No. 2, 161-171(Dec 1979).

From 5. international conference on structural mechanics in reactor technology (SMIRT-5) and 9. international seminar in conjunction with 2. international seminar on structural reliability of mechanical components and subassemblies of nuclear power plants and 2. international seminar on containment of fast breeder reactors; Berlin, Germany, F.R. (9 - 21 Aug 1979).

The aim of this paper is to provide hydrodynamic analysis of the fluid motion in the above core region and to study the effect of the upper internal structure on the slug impact as well as the primary system response. At ANL, two excursion containment codes. ICECO and ALICE, are chosen for such an analysis. These two codes, based on the ICE technique and ICED-ALE method, respectively, are ideal for analyzing flow through coolant passage-ways and flow blockage near the bottom plate. They also have other advantages, such as: (1) treating fluid motion around internal structure with geometrical discontinuities; (2) investigating excursions with large distortions; (3) handling two-dimensional sliding conditions; and (4) providing a stable solution throughout the entire excursion. In both ICECO and ALICE the upper internal structure can be modelled by rigid obstacles similar to the scheme used in the MAC method. The coolant passageways can be approximated by means of narrow cells. Another option is provided in the ICECO code in which the upper internal is considered as a perforated structure. In this model large cells can be used over the entire computational region. The analysis utilizes a control-volume technique to solve the conservation equations of mass, momentum, and energy. The basic idea is to use the actual fluid volume and the actual flow area in the mathematical formulation. Three modified Poisson equations are derived which govern the hydrodynamic pressures inside, above, and below the perforated structure. These three equations, in conjunction with the Poisson equation of the ICE technique as well as the relaxation equation at the moving boundary, are solved iteratively.

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 34614

34926 (UCID—18673) **Technical evaluation of the proposed design modifications and technical specification changes on grid voltage degradation for the H. B. Robinson Nuclear Generating Plant, Unit 2.** Selan, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1980. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01.

This report documents the technical evaluation of the proposed design modifications and technical specification changes on grid voltage degradation for the H. B. Robinson Nuclear Generating Plant Unit 2. The review criteria are based on IEEE Std. 279-1971, IEEE Std. 308-1974, and General Design Criterion 17 of the Code of Federal Regulations, Title 10, Part 50, Appendix A requirements for determining the acceptability of the proposed system to protect the Class 1E equipment from degradation of grid voltages.

ECONOMICS

34927 (ORNL/TM—7279) **Nuclear power generation cost methodology.** Delene, J.G.; Bowers, H.I. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 38p. NTIS, PC A03/MF A01.

A simplified calculational procedure for the estimation of nuclear power generation cost is outlined. The report contains a discussion of the various components of power generation cost and basic equations for calculating that cost. An example calculation is given. The basis of the fixed-charge rate, the derivation of the levelized fuel cycle cost equation, and the heavy water charge rate are included as appendixes.

FUEL CYCLE

REFER ALSO TO CITATION(S) 34612, 34947

34928 (ANL—80-40) **Fast Breeder Reactor studies.** Till, C.E.; Chang, Y.I.; Kittel, J.H.; Fauske, H.K.; Lineberry, M.J.; Stevenson, M.G.; Amundson, P.I.; Dance, K.D. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 431p. NTIS, PC A19/MF A01.

This report is a compilation of Fast Breeder Reactor (FBR) resource documents prepared to provide the technical basis for the US contribution to the International Nuclear Fuel Cycle Evaluation. The eight separate parts deal with the alternative fast breeder reactor fuel cycles in terms of energy demand, resource base, technical potential and current status, safety, proliferation resistance, deployment, and nuclear safeguards. An Annex compares the cost of decommissioning light-water and fast breeder reactors. Separate abstracts are included for each of the parts.

34929 (ANL—80-40, pp 1-30) **Part I. Alternative fuel-cycle and deployment strategies: their influence on long-term energy supply and resource usage.** Till, C.E.; Chang, Y.I.; Rudolph, R.R. Jul 1980.

In Fast Breeder Reactor studies.

This report examines the implications of alternative fast breeder fuel cycles and deployment strategies on long-term energy supply and uranium resource utilization. An international-aggregate treatment for nuclear energy demand and resource base assumptions was adopted where specific assumptions were necessary for system analyses, but the primary emphasis was placed on understanding the general relationships between energy demand, uranium resource and breeder deployment option. The fast breeder deployment options studied include the reference Pu/U cycle as well as alternative cycles with varying degrees of thorium utilization.

34930 (ANL—80-40, pp 31-108) **Part 2. Design and performance characteristics of alternative fuels and fuel cycles.** C.ang, Y.I.; Till, C.E. Jul 1980.

In Fast Breeder Reactor studies.

This report documents performance characteristics of a wide range of fast breeder reactor designs and fuel cycle options to provide the bases for the study of alternatives that is the primary focus of the International Nuclear Fuel Cycle Evaluation. Since breeding performance is at the center of many of the feasibility questions connected with alternative forms of breeder development, particular attention was given to a consistent comparison between various alternatives and quantitative analyses that provide physical understanding of intrinsic differences in their breeding performance.

34931 (ANL—80-40, pp 109-150) **Part 3. Status of LMFBR fuels and materials development.** Kittel, J.H.; Neimark, L.A.; Walters, L.G.; Einziger, R.E.; Mahagin, D.E. Jul 1980.

In Fast Breeder Reactor studies.

The status of development of the candidate LMFBR fuel type oxide, carbide and metal, cladding/duct alloys, and absorber material is reviewed. The three-fuel types are discussed for the reference breeder cycle, transmuter cycle, denatured cycle, and blanket fuel applications. The preferred design concepts for each fuel type are identified, with discussion of the more significant factors that control burnup and thermal performance for each design and fuel type. The key technical issues for each fuel and material are reviewed and the required effort to resolve the key issues is identified.

34932 (ANL—80-40, pp 192-279) **Part 5. Fuel cycle options.** Lineberry, M.J.; McFarlane, H.F.; Amundson, P.I.; Goin, R.W.; Webster, D.S. Jul 1980.

In Fast Breeder Reactor studies.

The results of the FBR fuel cycle study that supported US contributions to the INFCE are presented. Fuel cycle technology is reviewed from both generic and historical standpoints. Technology requirements are developed within the framework of three deployment scenarios: the reference international, the secured area, and the integral cycle. Reprocessing, fabrication, waste handling, transportation, and safeguards are discussed for each deployment scenario. Fuel cycle modifications designed to increase proliferation defenses are described and assessed for effectiveness and technology feasibility. The present status of fuel cycle technology is reviewed and key issues that require resolution are identified.

34933 (ANL—80-40, pp 280-304) **Part 6. Internationalization and collocation of FBR fuel cycle facilities.** Stevenson, M.G. (Los Alamos Scientific Lab., NM); Abramson, P.B.; LeSage, L.G. Jul 1980.

In Fast Breeder Reactor studies.

This report examines some of the non-proliferation, technical, and institutional aspects of internationalization and/or collocation of major facilities of the Fast Breeder Reactor (FBR) fuel cycle. The national incentives and disincentives for establishment of FBR Fuel Cycle Centers are enumerated. The technical, legal, and administrative considerations in determining the feasibility of FBR Fuel Cycle Centers are addressed by making comparisons with Light Water Reactor (LWR) centers which have been studied in detail by the IAEA and UNSRC.

34934 (ORNL/TM—7376) **Power generation costs for alternate reactor fuel cycles.** Smolen, G.R.; Delene, J.G. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 47p. NTIS, PC A03/MF A01.

The total electric generating costs at the power plant busbar are estimated for various nuclear reactor fuel cycles which may be considered for power generation in the future. The reactor systems include pressurized water reactors (PWR), heavy-water reactors (HWR), high-temperature gas cooled reactors (HTGR), liquid-metal fast breeder reactors (LMFBR), light-water pre-breeder and breeder reactors (LWPR, LWBR), and a fast mixed spectrum reactor (FMSR). Fuel cycles include once-through, uranium-only recycle, and full recycle of the uranium and plutonium in the spent fuel assemblies. The U_3O_8 price for economic transition from once-through LWR fuel cycles to both PWR recycle and LMFBR systems is estimated. Electric power generation costs were determined both for a reference set of unit cost parameters and for a range of uncertainty in these parameters. In addition, cost sensitivity parameters are provided so that independent estimations can be made for alternate cost assumptions.

PROCESS HEAT REACTORS

34935 (GA-A—15789) **850°C VHTR plant technical description.** (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76SF71061. 146p. NTIS, PC A07/MF A01.

This report describes the conceptual design of an 842-MW(t) process heat very high temperature reactor (VHTR) plant having a core outlet temperature of 850°C (1562°F). The reactor is a variation of the high-temperature gas-cooled reactor (HTGR) power plant concept. The report includes a description of the nuclear heat source (NHS) and of the balance of reactor plant (BORP) requirements. The design of the associated chemical process plant is not covered in this report. The reactor design is similar to a previously reported VHTR design having a 950°C (1742°F) core outlet temperature.

NUCLEAR REACTOR TECHNOLOGY

COMPONENTS AND ACCESSORIES

34936 (DP-MS—79-78) **Seismic response analysis for structures with non-orthogonal modes.** Yau, W.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 9p. (CONF-800804—21). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

For seismic analysis of structures in nuclear industry, the spectrum method of modal combination acceptable to US Nuclear Regulatory Commission is applicable only to systems with orthogonal natural modes. When a structure with frequency dependent boundary conditions is set in motion, its natural modes of vibration are generally non-orthogonal. Based on such a structure, the spectrum method of modal composition is generalized to include systems with non-orthogonal modes. The generalized expression for the participation factor of each model is reducible to that prescribed by NRC, when the natural modes of the system are orthogonal. To illustrate the generalized method, the model responses of a simple structure are analyzed in detail.

FUEL ELEMENTS

34937 (EGG-FM—5155) **Low enrichment aluminide fuel plate development program progress report for FY-1979.** Newton, D.G. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1980. Contract AC07-76ID01570. 16p. NTIS, PC A02/MF A01.

Accomplishments during FY-1979 were twofold. First, a facility for the fabrication of nuclear fuel platelets at the INEL was established. Second, fabrication studies (under contract to Argonne National Laboratory) were conducted to ascertain feasibility guidelines for subsequent commercial production of fuel plates containing very large loadings of low-enriched (<20% ^{235}U) uranium aluminide (UA1/sub x/). Preliminary results, using rectangular core compacts, confirm the possibility of producing fuel plates having fuel uniformly distributed therein, when fuel loadings were held to 40 volume percent UA1/sub x/ or less. When fuel loadings were

greater than 40 volume percent (viz., 48 and 56 volume percent), however, difficulty was encountered in producing fuel platelets with uniform core distributions; this was particularly notable when fine-grained (<44 μm) UA1/sub x/ was used.

34938 (LA-UR—80-2107) **Status of CINDER and ENDF/B-V based libraries for transmutation calculations.** Wilson, W.B.; England, T.R.; LaBauve, R.J.; Battat, M.E.; Wessol, D.E.; Perry, R.T. (Los Alamos Scientific Lab., NM (USA); Idaho National Engineering Lab., Idaho Falls (USA); Wisconsin Univ., Madison (USA)). 1980. Contract W-7405-ENG-36. 26p. (CONF-800743—6). NTIS, PC A03/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

The CINDER codes and their data libraries are described, and their range of calculational capabilities are described using documented applications. The importance of ENDF/B data and the features of the ENDF/B-IV and ENDF/B-V fission-product and actinide data files are emphasized. The actinide decay data of ENDF/B-V, augmented by additional data from available sources, are used to produce average decay energy values and neutron source values from sponteneous fission, (α,n) and delayed neutron emission for 144 actinide nuclides that are formed in reactor fuel. The status and characteristics of the CINDER-2 code is described, along with a brief description of more well known code versions; a review of the status of new ENDF/B-V based libraries for all versions is presented.

CONTROL SYSTEMS

34939 (CONF-800403—(Vol.1), pp 293-300) **Improved time series modeling approach for diagnosis and surveillance of reactors.** Kitamura, M.; Upadhyaya, B.R. (Univ. of Tennessee, Knoxville). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A procedure of random data processing, based on multivariate time series modeling, was developed for analyzing reactor noise signals. The purpose of the development is to resolve methodological ambiguities in using the time series analysis as a tool for surveillance and diagnostics of nuclear power plants. A standard procedure presented consists of several algorithms which test statistical properties of analyzed data and provide a measure of reliability of the extracted information. Noise data records of a boiling water reactor (BWR) were analyzed by this method. In addition to computing conventional noise signatures (i.e. auto- and cross-power spectra), the multivariate model was used for evaluating cause-and-effect relationship among signals, for short-term monitoring of process variables, and for monitoring stability of the BWR. The results illustrate the applicability of this method for reactor monitoring.

ENVIRONMENTAL ASPECTS

SITING

REFER ALSO TO CITATION(S) 35584

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 35536

34940 (CONF-800802—14) **Unit operations used to treat process and/or waste streams at nuclear power plants.** Godbee, H.W.; Kibbey, A.H. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 47p. NTIS, PC A03/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Estimates are given of the annual amounts of each generic type of LLW [i.e., Government and commerical (fuel cycle and non-fuel cycle)] that is generated at LWR plants. Many different chemical engineering unit operations used to treat process and/or waste streams at LWR plants include adsorption, evaporation, calcination, centrifugation, compaction, crystallization, drying, filtration, incineration, reverse osmosis, and solidification of waste residues. The treatment of these various streams and the secondary wet solid wastes thus generated is described. The various treatment options for concentrates or solid wet wastes, and for dry wastes are discussed. Among the dry waste treatment methods are compaction, baling, and incineration, as well as chopping, cutting and shredding. Organic materials [liquids (e.g., oils or solvents) and/or solids], could be incinerated in most cases. The filter sludges, spent resins, and concentrated liquids (e.g., evaporator concentrates) are usually solidified in cement, or urea-formaldehyde or unsaturated polyester resins prior to burial. Incinerator ashes can also be incorporated in these binding agents. Asphalt has not yet been used. This paper presents a brief survey of operational experience at LWRs with various unit operations, including a short discussion of problems and some observations on recent trends.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 35584

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 34937, 35355

34941 (CONF-800682—1) **In-place testing of off-gas iodine filters.** Duce, S.W.; Tkachyk, J.W.; Motes, B.G. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 15p. NTIS, PC A02/MF A01.

From 35. Northwest 5. biennial Rocky Mountain joint meeting of the American Chemical Society; Salt Lake City, UT, USA (12 Jun 1980).

At the Idaho National Engineering Laboratory, both charcoal and silver zeolite (AgX) filters are used for radioactive iodine off-gas cleanup of reactor systems. These filters are used in facilities which are conducting research in the areas of reactor fuel failure, reactor fuel inspection, and loss of fluids from reactor vessels. Iodine retention efficiency testing of these filters is dictated by prudent safety practices and regulatory guidelines. A procedure for determining iodine off-gas filter efficiency in-place has been developed and tested on both AgX and charcoal filters. The procedure involves establishing sample points upstream and downstream of the filter to be tested. A step-by-step approach for filter efficiency testing is presented.

34942 (CONF-800747—6) **Treatment of measurement uncertainties at the power burst facility.** Meyer, L.C. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01.

From Review group conference on advanced instrumentation for reactor safety research; Oak Ridge, TN, USA (29 Jul 1980).

The treatment of measurement uncertainty at the Power Burst Facility provides a means of improving data integrity as well as meeting standard practice reporting requirements. This is accomplished by performing the uncertainty analysis in two parts, test independent uncertainty analysis and test dependent uncertainty analysis. The test independent uncertainty analysis is performed on instrumentation used repeatedly from one test to the next, and does not have to be repeated for each test except for improved or new types of instruments. A test dependent uncertainty analysis is performed on each test based on the test independent uncertainties modified as required by test specifications, experiment fixture design, and historical performance of instruments on similar tests. The methodology for performing uncertainty analysis based on the National Bureau of Standards method is reviewed with examples applied to nuclear instrumentation.

34943 (HEDL-SA—1825-FP) **Scale-model characterization of flow-induced vibrational response of FFTF reactor internals.** Ryan, J.A.; Mahoney, J.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1980. Contract AC14-76FF02170. 22p. (CONF-801002—3). NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Fast Test Reactor core internal and peripheral components were assessed for flow-induced vibrational characteristics under scaled and simulated prototype flow conditions in the Hydraulic Core Mockup as an integral part of the Fast Test Reactor Vibration Program. The Hydraulic Core Mockup was an 0.285 geometric scale model of the Fast Test Reactor internals designed to simulate prototype vibrational and hydraulic characteristics. Using water to simulate sodium coolant, vibrational characteristics were measured and determined for selected model components over the scaled flow range of 36 to 110%. Additionally, in-situ shaker tests were conducted on selected Hydraulic Core Mockup outlet plenum components to establish modal characteristics. Most components exhibited resonant response at all test flow rates; however, the measured dynamic response was neither abnormal nor anomalously flow-rate dependent, and the predicted prototype components' response were deemed acceptable.

34944 (HEDL-SA—2034) **FFTF auxiliary system testing program: results and overview (posters).** Bliss, R.J.; Hunter, J.R. (Hanford Engineering Development Lab., Richland, WA (USA); Department of Energy, Washington, DC (USA)). Dec 1979. Contract AC14-76FF02170. 11p. (CONF-800248—2). NTIS, PC A02/MF A01.

From American Nuclear Society conference; Las Vegas, NV, USA (3 Feb 1980).

The most important aspects of the Auxiliary System Testing Program to the overall startup of FFTF were in the areas of

integrated testing of inerted cells, integrated leak rate testing of the containment building and testing of the waste gas processing systems for effluent cover gas and effluent cell atmosphere gases. The basic test methods and test results for these areas of the FFTF startup program are presented.

34945 (ORNL/TM—7314) **Oak Ridge Research Reactor quarterly report, October-December 1979.** Hurt, S.S. III; Lance, E.D. (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 35p. NTIS, PC A03/MF A01.

The ORR operated at an average power level of 29.7 MW for 84.9% of the time during October, November, and December of 1979. The reactor was shut down on thirteen occasions, two of which were unscheduled. Reactor downtime needed for refueling, maintenance, and checks was normal, with the reactor remaining available for operation 89.9% of the time. Maintenance activities, both mechanical and instrument, were essentially routine in nature with the exception of one Reactor Instrument and Controls Design Change Memo and non-routine maintenance on the control rod drives. In-service inspection completed during the quarter included visual inspection of the secondary side of the reactor heat exchanger (No. 4 unit).

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

34946 (ORNL/TM—7451) **High Flux Isotope Reactor. Quarterly report, October, November, and December 1979.** Corbett, B.L.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

Routine reactor operation with four end-of-cycle shutdowns and one scheduled midcycle shutdown resulted in an on-stream time of 93.6% for the quarter. This gave the HFIR an on-stream time for the year of 91.3%. The outer control plates were replaced, and the annual core components inspection was made.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 35196, 35274

34947 (ANL—80-40, pp 151-191) **Part 4. Safety implications of alternative fuel types.** Fauske, H.K. Jul 1980.

In Fast Breeder Reactor studies.

This report provides an assessment of safety implications associated with alternatives relative to the reference (U,Pu) oxide fuel in fast breeder reactors. The alternatives considered include thorium- and uranium-based oxide, carbide and metal fuel types for the LMFBR and oxide fuel types for the GCFR. Major emphasis is put on low probability, but potentially large-consequence accidents, e.g., core-disruptive accidents (CDAs).

34948 (CONF-800403—(Vol.1)) **Thermal Reactor Safety.** (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 712p. NTIS, PC A99/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Information is presented concerning fire risk and protection; transient thermal-hydraulic analysis and experiments; class 9 accidents and containment; diagnostics and in-service inspection; risk and cost comparison of alternative electric energy sources; fuel behavior and experiments on core cooling in LOCAs; reactor event reporting analysis; equipment qualification; post facts analysis of the TMI-2 accident; and computational methods.

34949 (CONF-800403—(Vol.1), pp 72-80) **Frequency of fires in light water reactor compartments.** Apostolakis, G.; Kazarians, M. (Univ. of California, Los Angeles). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Bayesian analysis is employed to derive distributions for the frequeny of fires in the control room, the cable spreading room, the Diesel room, tha containment, the turbine building and the auxiliary building. The mean frequencies (per compartment year) are: control room: 4.1×10^{-3}; cable spreading room: 7.2×10^{-3}; Diesel room: 1.9×10^{-2}; containment: 1.6×10^{-2}; turbine building: 3.4×10^{-2}. The distributions are determined mainly by the statistical evidence and they are insensitive to the particular choice of the prior distribution, as long as the latter represents vague prior knowledge.

34950 (CONF-800403—(Vol.1), pp 81-86) **Pre-fire planning for nuclear power plants.** Talbert, J.H. (FPR Group, West Chicago, IL). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Regardless of the fire prevention measures which are taken, plant experience indicates that fires will occur in a nuclear power plant. When a fire occurs, the plant staff must handle the fire emergency. Pre-fire planning is a method of developing detailed fire attack plans and salvage operations to protect equipment from damage due to fire and fire fighting operations. This paper describes the purpose and use of a pre-fire plan to achieve these goals in nuclear power plants.

34951 (CONF-800403—(Vol.1), pp 110-117) **Reporting requirements for fire protection and risk assessment in nuclear power plants.** Yeater, M.L. (Rensselaer Polytechnic Inst., Troy, NY); Hockenbury, R.W.; Jackson, P.S.; Sideris, A.G.; Mariani, L.P. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

During a review and analysis of fires occurring in nuclear power plants it has become clear that improved reporting and records are essential for future risk modelling and protective design and planning. Current reporting results are reviewed and additional needed factors and records are identified.

34952 (CONF-800403—(Vol.1), pp 119-126) **Marviken Critical Flow Test Program.** Schultz, R.R. (EG and G Idaho, Idaho Falls); Ericson, L. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A multinational project, the Marviken Full Scale Critical Flow Tests conducted twenty-seven tests to obtain critical mass flow data for short nozzle geometries (200 to 509 mm diameters with length to diameter ratios from 0.3 to 3.7) comparable to pipe sizes present in world nuclear reactor stations. Typical data are presented and discussed. The nozzle inlet pressures ranged from 5.2 to 2.6 MPa with the fluid subcooled as much as 50°C to low quality saturation. A maximum nozzle mass flow rate of 14 Mg/s was measured. The data provide an important link between the previously available small scale critical mass flow rate data and existing operational hardware.

34953 (CONF-800403—(Vol.1), pp 135-144) **Analysis of a stuck open PORV in the pressurizer of the Maine Yankee Reactor.** Brown, G.J. (Univ. of Lowell, MA); Schor, L.; Husain, A.; Turnage, J.C. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A stuck open power operated relief valve (PORV) (area 8.75 $\times 10^{-4} m^2$) in the pressurizer of the Maine Yankee Reactor has been analyzed using the RELAP4-EM and TOODEE-2 computer codes. The reactor, modeled to be operating at full power when the PORV opens, loses pressure and eventually scrams at 151.4 seconds into the transient. At the time of the reactor scram there is an assumed loss of power to the primary pumps and isolation of the steam generators by closure of the main feedwater and steam valves. The energy removed through the open valve plus heat transferred to the steam generators is more than adequate to keep the reactor from overheating. At 2880 seconds into the transient, assuming no secondary feedwater, the flow out the PORV starts to remove more energy than is being produced by core decay heat.

34954 (CONF-800403—(Vol.1), pp 189-196) **Reduction in reactor risk by the mitigation of accident consequences.** Denning, R.S. (Battelle, Columbus Labs., OH). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Approaches are examined to reducing the public risk from nuclear power reactors by the use of safety systems which would control the consequences of core meltdown accidents. The mechanisms which could lead to failure of the containment are identified. Engineered safety features are then described which would reduce the likelihood of containment failure or reduce the subsequent release of radioactivity to the environment. The potential for reducing risk is assessed and for some safety features is found to be significant. However, in order to realize a major reduction in risk, a systematic analysis of system interactions must be performed.

34955 (CONF-800403—(Vol.1), pp 579-581) **Three Mile Island system thermal-hydraulic analysis using TRAC.** Ireland, J.R. (Los Alamos Scientific Lab., NM). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The Three Mile Island (TMI) nuclear plant was modeled using the Transient Reactor Analysis Code (TRAC) and a preliminary calculation, which simulated the initial part of the accident that occurred on March 28, 1979, was performed. The purpose of this calculation was to provide a better understanding of the system thermal-hydraulic response during the first 3 h of the accident and to evaluate how well TRAC results compared to the overall accident scenario and measured system parameters. The calculated system pressure, loop temperatures, and pressurizer level are all in good agreement with measured data.

34956 (CONF-800403—(Vol.1), pp 597-613) **Modelling of the liquid level during uncovering of the TMI-2 core.** Ardron, K.H.; Cain, D.G. (NSAC, Palo Alto, CA). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Calculation of the path followed by the falling liquid level in the core is an important part of the analysis of fuel heat-up, and the damage sustained in the accident at TMI-2. This paper describes the development and application of a model for predicting liquid level in the TMI-2 core during uncovering. The calculational method is shown to give a satisfactory representation of level height data obtained in TMI boil-down simulation tests in the Semi-scale facility. The model is combined with a best estimate of make-up flow to the TMI-2 core to calculate the level trajectory during core uncovering. Results are found to be sensitive to the assumed degree of steam condensation on the make-up flow.

34957 (CONF-800403—(Vol.1), pp 632-638) **Computational methods with respect to LOCA transient analysis.** Liles, D.R.; Mahaffy, J.H. (Los Alamos Scientific Lab., NM). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

LOCA simulation presents a wide range of problems to the analyst. Widely differing time scales for the important physical phenonema require the use of numerical schemes with high levels of implicitness and robust characteristics. The TRAC computer code has been designed using economical yet stable finite difference algorithms. The important short time constant phenonema are incorporated implicity and blended schemes allow material Courant limits to be exceeded in some of the one dimensional components. A new two-step procedure will allow future versions to handle small break LOCA's even more efficiently.

34958 (CONF-800403—(Vol.1), pp 639-646) **Momentum and mass exchange in countercurrent flow in PWR geometries.** Segev, A.; Collier, R.P. (Battelle-Columbus Labs., OH). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Interfacial momentum and mass exchange in a PWR downcomer were investigated. A new momentum transfer correlation was developed from air-water experiments in 1/15- and 2/15-scale models of a PWR with standard and distorted geometries. The correlation is based on the Kutateladze parameter and indicates that the overall momentum transfer does not depend on scale for geometrically similar models. Mass exchange has been included by evaluating the effective gas flow for momentum transfer. Predictions of the modified correlation agree quite well with experimental results of stream-water flows in PWR scaled models.

34959 (CONF-800403—(Vol.2)) **Thermal reactor safety.** (Oak Ridge National Lab., TN (USA)). Jun 1980. Contract W-7405-ENG-26. 712p. NTIS, PC A99/MF A01.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Information is presented concerning new trends in licensing; seismic considerations and system structural behavior; TMI-2 risk assessment and thermal hydraulics; statistical assessment of potential accidents and verification of computational methods; issues with respect to improved safety; human factors in nuclear power plant operation; diagnostics and activities in support of recovery; LOCA transient analysis; unresolved safety issues and other safety considerations; and fission product transport.

34960 (CONF-800403—(Vol.2), pp 696-703) **Conflicts about nuclear power safety: a decision theoretic approach.** Winterfeldt, D.V. (Univ. of Southern California, Los Angeles); Rios, M. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A series of psychological studies indicate that people's judgements of risks from energy production in general and nuclear power plants in particular deviate from technical and statistical estimates because social and psychological variables influence people's risk perception. After reviewing these studies a decision analytic methodology is outlined which incorporates such social and psychological variables in a formal analysis of the risks and benefits of nuclear energy production. The methodology is intended to identify groups with differing risk-benefit perceptions and to elicit and quantify their values and concerns. Such group and value structures are presented for the problem of choosing between a nuclear plant, a coal plant, and a conservation strategy.

34961 (CONF-800403—(Vol.2), pp 712-719) **Systems interaction methodology development.** Boyd, G.J.; Carlson, D.D.; Cramond, W.R.; Hatch, S.W.; Hickman, J.W.; Kolaczkowski, A.M.; Stack, D.W. (Sandia National Labs., Albuquerque, NM). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A program to identify and evaluate potential systems interactions in pressurized water reactors was conducted for the NRC. Fault trees were developed for three functions needed to prevent core damage: loss of the reactor coolant pressure boundary, failure to remove decay heat, and failure to achieve or maintain reactor subcriticality. The objectives were to develop a methodology with criteria for revealing important systems interactions and to assess the Standard Review Plan (SRP) for completeness regarding systems interactions. Computer analysis of the fault trees using linking characteristics between system components resulted in minimal cut sets which were then studied for important interactions. It was found that the SRP did not specifically address: actuation and location of pressurizer relief and isolation valves, cooling and location of auxiliary feedwater pumps, and power to the pressurizer heaters. Application of the methodology to an exemplary plant indicated that the types of systems interactions within the program scope were not a problem.

34962 (CONF-800403—(Vol.2), pp 891-898) **Alternative event sequences or, what more could have gone wrong.** Stratton, W.R. (Los Alamos Scientific Lab., NM); Fontana, N.H.; Seale, R.L.; Reynolds, A.B. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The sequence of events in the TMI-2 accident was examined to determine if one or more equipment malfuction or operator action could have changed the consequences significantly. Most such scenarios were benign, but a couple were explored whose consequences were more difficult to calculate. To assume a conservative evaluation, conditions leading unequivocally to fuel melting were postulated and the subsequent events examined. It was found that for this accident, the integrity of containment would not have been successfully challenged by a steam explosion, over-pressure, or by penetration of the concrete by molten fuel. An associated conclusion was that off-site releases of iodine would not have been changed significantly.

34963 (CONF-800403—(Vol.2), pp 908-915) **RETRAN natural circulation analyses during the Three Mile Island Unit 2 accident.** Denver, D.J. (Energy Inc., Richmond, VA); Harrison, J.F. Jr.; Trikouros, N.G. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

This paper discusses the RETRAN natural circulation analyses which were performed on an emergency basis during the Three Mile Island Unit 2 (TMI-2) Accident in support of the decision to make the transition from forced flow to natural circulation heat removal. The conditions which existed in the containment following the core damage which occurred on March 28, 1979 precluded the long-term use of forced convective core cooling to dissipate fission product decay heat. Natural circulation which uses only the buoyant force of heated water to circulate coolant through the core, was proposed as the most reliable long-term heat removal method. Before the transition could be made, however, it was necessary to determine the capability of the system to successfully achieve stable natural circulation in its damaged state and to evaluate the various modes of steam generator operation which were being proposed for use in this cooling mode.

34964 (CONF-800403—(Vol.2), pp 942-949) **Application of advanced unavailability models to redundant safety systems.** Vaurio, J.K. (Argonne National Lab., IL); Sciaudone, D. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Comprehensive availability models and computer codes have been developed for analyzing redundant standby safety systems with components tested periodically. Common-mode failures not detectable by periodic tests and a variety of other human and hardware failures have been included in the models for consecutive, staggered and random testing schemes. Using model parameters extracted from recorded data, the methods have been used for sensitivity studies and for optimizing the redundancy and testing. Applications to an auxiliary feedwater system of a typical PWR 3-loop design indicate that diesel generators with high failure rates are critical components, but common-mode failures currently limit the benefits of optimization and increasing redundancy.

34965 (CONF-800403—(Vol.2), pp 975-982) **COBRA-TF reflood model and analysis of FLECHT reflood experiments.** Kelly, J.M.; Thurgood, M.J. (Battelle, Pacific Northwest Lab., Richland, WA). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

COBRA-TF, a two-fluid, three-field transient thermal hydraulic analysis code is being developed at PNL. To simulate bottom reflood tests, both a reflood entrainment model and a quench front model have been developed. Qualification of this model is underway and several FLECHT forced reflood tests (3 to 15 cm/sec reflood rate) have been simulated. Generally good data comparisons were achieved, though areas for further improvement were indicated.

34966 (CONF-800403—(Vol.2), pp 1056-1063) **Human factors in nuclear power plant operation.** Sabri, Z.A. (Iowa State Univ., Ames); Husseiny, A.A. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

An extensive effort is being devoted to developing a comprehensive human factor program that encompasses establishment of a data base for human error prediction using past operation experience in commercial nuclear power plants. Some of the main results of such an effort are reported including data retrieval and classification systems which have been developed to assist in estimation of operator error rates. Also, statistical methods are developed to relate operator error data to reactor type, age, and specific technical design features. Results reported in this paper are based on an analysis of LER's covering a six-year period for LWR's. Developments presently include a computer data management program, statistical model, and detailed error taxonomy.

34967 (CONF-800403—(Vol.2), pp 1064-1071) **Relation of management, supervision, and personnel practices to nuclear power plant safety.** Layton, W.L.; Turnage, J.J. (Science Applications, Inc., Ames, IA). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The knowledge base of industrial/organization psychology suggests three major areas of research with important implications for nuclear power plant safety. These areas are: Management and Supervision: Personnel Selection, Training and Placement; and Organizational Climate. Evidence drawn from several Three Mile Island investigations confirms that organizational structure of plants and supervisory practices, the selection and training of personnel, and organizational climate are important factors. Difficulties in decision making and coordination of personnel are pinpointed. Deficiencies in training are highlighted and the climate of working atmosphere is discussed. These matters are related to nuclear power plant safety. Future research directions are presented.

34968 (CONF-800403—(Vol.2), pp 1072-1078) **Estimation of operator hazard function based on commercial nuclear power plant experience.** Azarm, A.M. (Science Applications, Inc., Ames, IA); Husseiny, A.A.; Sabri, Z.A. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A statistical operator reliability function is synthesized for the operation of commercial nuclear power plants. The model is developed in a form appropriate for estimating and predicting a hazard function utilizing the Kalman filtering methodology. Data on operator events has been extracted from the Licensee Event Reports (LER's) for all US Commercial Light Water Reactors from 1972-1977. The data was used to compute error rates which were then employed in the application of the model to examine effects due to age, power level, and reactor type on the operator hazard function.

34969 (CONF-800403—(Vol.2), pp 1079-1087) **Identification of programs for improved operator performance based on past experiences in commercial Light Water Reactors.** McLagan, G.P. (Science Applications, Inc., Ames, IA); Husseiny, A.A.; Sabri, Z.A. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Over 11,000 Licensee Event Reports (LER's) were manually reviewed for all Light Water Reactors (LWR's) from the period January 1972 through December 1977. Five hundred and twelve total operator errors (OE's) were identified, accounting for approximately 3.0 and 2.6 OE's per PWR and BWR reactor year of operation, respectively. Specific failure modes resulting in OE's have been identified with respect to systems and components involved. Operator error significance has been qualitatively determined. The development of frequency/consequence matrices has enabled an importance ranking for operator improvement programs.

34970 (CONF-800403—(Vol.2), pp 1118-1121) **Post-accident reactor assessment by dynamic measurements.** Zigler, G.L. (Science Applications, Inc., Oak Ridge, TN). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

During the thirty days following the initiating event of the Three Mile Island Unit 2 accident, vital information to assess the condition of the degraded primary system was acquired by means of dynamic measurements. Three areas, out of the numerous dynamic measurements performed, are discussed: structural-mechanical evaluation of the primary system, non-condensible entrained gas volume calculations (bubble size), and primary system instrumentation degradation monitoring. In each of these areas, only through the techniques used could the needed information of the status of the primary system be reliably acquired.

34971 (CONF-800403—(Vol.2), pp 1198-1204) **Comparison of RELAP5 calculations with level swell and counter-current flow phenomena.** Mecham, D.C.; Wells, J.C.; Feinauer, L.R. (Intermountain Technologies, Inc., Idaho Falls, ID). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Independent calculations with RELAP5 have demonstrated an advanced state-of-the-art in thermal-hydraulic analysis. Level swell was investigated by analyzing a single vessel blowdown experiment. RELAP5 reasonably predicts void distribution without direct correlations for slip velocity or bubble rise models. Countercurrent flow was studied by analyzing steady-state flow at atmospheric pressure in an 8 x 8 rod bundle. Initial RELAP5 results using the full flow regime map showed alternating periods of liquid downflow and vapor upflow. By using only the annular flow drag correlation, a realistic flooding curve was generated by RELAP5.

34972 (CONF-800403—(Vol.2), pp 1205-1212) **Semiscale small break analysis with RETRAN.** Sawtelle, G.R.; Minner, G.L. (Energy Inc., Idaho Falls, ID). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The thermal-hydraulic codes in general use today for system calculations have been heretofore developed for analyses of loss-of-coolant accidents following the postulated rupture of a large coolant pipe. The RETRAN computer program, which was developed from a RELAP code, can be included in this category. This paper reports application of the RETRAN program to analyses of a small break experiment (S-02-6, performed at the Semiscale facility). Two base calculations were performed, (1) an HEM calculation with the released version of RETRAN and (2) an analysis with a developmental version of the code which allows for separate phase velocity calculations.

34973 (CONF-800403—(Vol.2), pp 1229-1239) **Prediction of critical heat flux during transients.** Leung, J.C.M.; Gallivan, K.A. (Argonne National Lab., IL). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The onset of CHF during flow and pressure transients was predicted using steady-state CHF correlations together with a simple thermal-hydraulic code. Transient data were collected in various power-profile test sections at the ANL Freon-11 loop. The CISE Freon correlation which has successfully correlated the ANL steady-state CHF data, was employed in the transient predictions. For the slow flow-decay transients, both local-conditions (LC) and boiling-length (BL) predictions were found to be adequate. However for the rapid transients with inlet-flow blockage, the LC prediction gave better results than the BL method. Combined inlet-flow blockage and depressurization data were also in good agreement with the LC prediction. The present prediction also yielded good results for the Moxon-Edward and Cumo flow decay data. Finally a Combustion Engineering single-tube blowdown test was analyzed and all three round-tube water correlations (Bowring, Biasi, and CISE) were demonstrated to correlate the data reasonably well.

34974 (CONF-800403—(Vol.2), pp 1250-1257) **Unresolved problems related to the performance of containment recirculation sumps.** Durgin, W.W. (Alden Research Lab., Holden, MA); Padmanabhan, M.; Watt, J.J.; Weigand, G.G. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

Experiments are being conducted at full geometric scale to investigate the performance of containment sumps during the recirculation mode of the ECCS. Such sumps are prone to vortex formation and perform poorly if break-flow jets impinge nearby. If they do not function well, air and poor flow conditions can exist in the pump approach piping. Since these systems must function for long periods of time unattended, it is necessary to understand the effect of flow configurations, geometric configurations, and vortex suppression techniques.

34975 (CONF-800403—(Vol.2), pp 1266-1272) **Application of partial failure analysis to an accident involving loss of cooling in a spent fuel storage pool.** Lofgren, E.(Science Applications, Inc., McLean, VA); Denning, R.S.; Cudnik, R.A.; Hall, R.E. Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A method is described for extending event tree methodology to the evaluation of systems which are better represented by a spectrum of operational modes than by two discrete modes. The methods are applied to the analysis of the risk to the public from failure of the decay heat removal system in a spent fuel storage pool.

34976 (CONF-800403—(Vol.2), pp 1281-1288) **Probabilistic safety analysis for shipping liquefied petroleum gas in the vicinity of a nuclear power plant.** Schmidt, E.R.; Broadhurst, R.H.; Li, C.Y. (NUS Corp., Rockville, MD). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A probabilistic safety analysis has been performed for truck and rail transportation of liquefied petroleum gas (PG) in the vicinity of a nuclear power plant. Site-specific truck and rail accident data were combined with nationwide commodity-specific data to give a spill probability representative of local conditions. This information was used with cloud formation and atmospheric dispersion models to determine both the annual probability of excessive overpressure at plant structures and the annual probability of a flammable gas mixture at plant air intakes. Results are presented as a function of overpressure and plant-to-transportation route distance.

34977 (CONF-800403—(Vol.2), pp 1306-1313) **Iodine scrubbing in steam generator tube rupture accidents.** Baybutt, P.; Cudnik, R.A.; Raghuram, S. (Battelle, Columbus Labs., OH). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

A computer code called WISE has been written to analyze iodine behavior in SGTR accidents. The code has been used to investigate the effects of water droplets which may be entrained in steam bubbles on iodine removal by the secondary water. Additionally, a sensitivity study has been performed to determine which variables have the greatest impact on iodine behavior. The iodine mass transfer coefficient from steam and the bubble rise velocity were found to have the greatest effect on iodine removal by the secondary water. Bubble moisture fraction was more important than droplet size. Changing the bubble moisture fraction from 0.83 to 0 for bubble rise heights of 0.25 and 5 m resulted in an increase in the iodine decontamination factor from 0.8 to 1.0 and from 0.09 to 0.9, respectively.

34978 (CONF-800403—(Vol.2), pp 1322-1327) **Assessment of LWR primary system radionuclide retention in meltdown accidents using the TRAP computer code.** Baybutt, P.; Gieseke, J.A.; Jordan, H.; Raghuram, S. (Battelle, Columbus Labs., OH). Jun 1980.

From ANS thermal reactor safety meeting; Knoxville, TN, USA (8 Apr 1980).

The TRAP computer code has been used to determine the extent of radionuclide deposition in LWR primary systems during meltdown accidents. Uncertainty analyses have been performed to provide insight into the key variables and prinicpal areas of uncertainty in modeling radionuclide behavior. Results of the calculations indicate that the extent of radionuclide deposition in the primary system varies widely with chemical species and accident conditions. Key contributions to uncertainty in the radionuclide deposition come from the radionuclide source term from the fuel and radionuclide deposition rates.

34979 (CONF-800802—10) **Recent chemical engineering requirements as the result of TMI on-site experience.** Brooksbank, R.E. Sr. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

From the experiences gained from the on-site experience at TMI, it is apparent that the role of chemical engineers should increase in order for the nuclear option to proceed in a safe and efficient fashion. It is also obvious that as the results of the reports investigating the causes and effects of the accident come to light and attempts to backfit system designs to prevent a recurrence are studied, more technical demands will be placed on the profession.

34980 (CONF-800804—26) **Experimental investigation of a flow monitoring instrument in an upper plenum of an air-water reflood test facility.** Combs, S.K.; Hardy, J.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 33p. NTIS, PC A03/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Instrumentation was developed for measuring fluid phenomena in the upper plenum of pressurized water reactor reflood facilities. In particular, the instrumentation measured two-phase flow velocity and void fraction. The principle of operation of the instrumentation scheme was based on the measurement of electrical impedance. The technique of analysis of random signals from two spatially separated impedance sensors was employed to measure two-phase flow velocity. A relative admittance technique was used to determine void fraction. The performance of the instrumentaton was studied in an air-water test facility.

34981 (CONF-801002—1) **Thermal-hydraulics of the PFB/LOFT lead rod loss-of-coolant experiments.** Varacalle, D.J. Jr.; Garner, R.W.; MacDonald, P.E.; Cox, W.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 36p. NTIS, PC A03/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Results of the four PBF/LOFT Lead Rod sequential blowdown tests conducted in the Power Burst Facility (PBF) are presented. The primary objective of the test series was to evaluate the extent of mechanical deformation that would be expected to occur to low pressure (0.1 MPa), light water reactor design fuel rods subjected to a series of nuclear blowdown tests, and to determine if subjecting deformed fuel rods to subsequent testing would result in rod failure. The extent of mechanical deformation (buckling, collapse, or waisting of the cladding) was evaluated by comparison of cladding temperature versus system pressure response with out-of-pile experimental data, and by posttest visual examinations and cladding diametral measurements. Tests LLR-3, LLR-5, LLR-4, and LLR-4A were performed at system conditions of 595°K coolant inlet temperature, 15.5 MPa system pressure, and 41, 46, 57 and 56 kW/m test rod peak linear powers, respectively, at initiation of blowdown. Cladding temperatures during the tests ranged from 870 to 1260°K.

34982 (CONF-801002—2) **Application of RELAP5 to a pipe blowdown experiment.** Carlson, K.E.; Ransom, V.H.; Wagner, R.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 15p. NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

The application of the RELAP5 computer program to a pipe blowdown experiment is described in this paper. The basic hydrodynamic model, constitutive relations, and special process models included in RELAP5 are also briefly discussed. The results of this application confirm the effectiveness of using a choked flow model.

34983 (GA-A—15314) **Licensing topical report: application of probabilistic risk assessment in the selection of design basis accidents.** Houghton, W.J. (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76ET35300. 50p. NTIS, PC A03/MF A01.

A probabilistic risk assessment (PRA) approach is proposed to be used to scrutinize selection of accident sequences. A technique is described in this Licensing Topical Report to identify candidates for Design Basis Accidents (DBAs) utilizing the risk assessment results. As a part of this technique, it is proposed that events with frequencies below a specified limit would not be candidates. The use of the methodology described is supplementary to the traditional, deterministic approach and may result, in some cases, in the selection of multiple failure sequences as DBAs; it may also provide a basis for not considering some traditionally postulated events as being DBAs. A process is then described for selecting a list of DBAs based on the candidates from PRA as supplementary to knowledge and judgments from past licensing practice. These DBAs would be the events considered in Chapter 15 of Safety Analysis Reports of high-temperature gas-cooled reactors (HTGRs).

34984 (GA-A—15920) **Probabilistic risk assessment of HTGRs.** Fleming, K.N.; Houghton, W.J.; Hannaman, G.W.; Joksimovic, V. (General Atomic Co., San Diego, CA (USA)). Aug 1980. Contract AT03-76ET35300. 14p. (CONF-800946—3). NTIS, PC A02/MF A01.

From IAEA specialists meeting on gas cooled reactor safety and licensing aspects; Lausanne, Switzerland (1 Sep 1980).

Probabilistic Risk Assessment methods have been applied to gas-cooled reactors for more than a decade and to HTGRs for more than six years in the programs sponsored by the US Department of Energy. Significant advancements to the development of PRA methodology in these programs are summarized as are the specific applications of the methods to HTGRs. Emphasis here is on PRA as a tool for evaluating HTGR design options. Current work and future directions are also discussed.

34985 (GA-A—15926) **HTGR safety research program.** Barsell, A.W.; Olsen, B.E.; Silady, F.A. (General Atomic Co., San Diego, CA (USA)). Aug 1980. Contract AT03-76ET35300. 15p. (CONF-800946—4). NTIS, PC A02/MF A01.

From IAEA specialists meeting on gas cooled reactor safety and licensing aspects; Lausanne, Switzerland (1 Sep 1980).

An HTGR safety research program is being performed supporting and guided in priorities by the AIPA Probabilistic Risk Study. Analytical and experimental studies have been conducted in four general areas where modeling or data assumptions contribute to large uncertainties in the consequence assessments and thus, in the risk assessment for key core heat-up accident scenarios. Experimental data have been obtained on time-dependent release of fission products from the fuel particles, and plateout characteristics of condensible fission products in the primary circuit. Potential failure modes of primarily top head PCRV components as well as concrete degradation processes have been analyzed using a series of newly developed models and interlinked computer programs. Containment phenomena, including fission product deposition and potential flammability of liberated combustible gases have been studied analytically.

34986 (GA-A—16033) **HTGR safety philosophy.** Joskimovic, V.; Fisher, C.R. (General Atomic Co., San Diego, CA (USA)). Aug 1980. Contract AT03-76ET35300. 15p. (CONF-800946—2). NTIS, PC A02/MF A01.

From IAEA specialists meeting on gas cooled reactor safety and licensing aspects; Lausanne, Switzerland (1 Sep 1980).

The accident at the Three Mile Island has focused public attention on reactor safety. Many public figures advocate a safer method of generating nuclear electricity for the second nuclear era in the US. The paper discusses the safety philosophy of a concept deemed suitable for this second nuclear era. The HTGR, in the course of its evolution, included safety as a significant determinant in design philosophy. This is particularly evident in the design features which provide inherent safety. Inherent features cause releases from a wide spectrum of accident conditions to be low. Engineered features supplement inherent features. The significance of HTGR safety features is quantified and order-of-magnitude type of comparisons are made with alternative ways of generating electricity.

34987 (K/CSD/INF—79/22) **Application of the finite element method to the two-dimensional nonlinear inverse heat conduction problem.** Bass, B.R.; Ott, L.J. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1980. Contract W-7405-ENG-26. 14p. (CONF-800916—1). NTIS, PC A02/MF A01.

From 1. international conference on numerical methods for nonlinear problems; Swansea, UK (2 Sep 1980).

The calculation of the surface temperature and surface heat flux from measured temperature transients at one or more interior points of a body is identified in the literature as the inverse heat conduction problem. An inverse solution technique applicable to the two-dimensional nonlinear model with temperature dependent thermophysical properties is presented. The technique utilizes a finite element heat conduction model and a generalization of Beck's one-dimensional nonlinear estimation procedure. Results are presented to demonstrate that the inverse formulation is capable of successfully treating experimental data.

34988 (LA-UR—79-3017) **Finite element modeling of fluid/thermal/structural interaction for a gas-cooled fast reactor core.** Bennett, J.G.; Ju, F. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. (CONF-801003—1). NTIS, PC A02/MF A01.

From Symposium on computational methods in nonlinear structural and solid mechanics; Washington, DC, USA (6 Oct 1980).

At the Los Alamos Scientific Laboratory (LASL), out-of-pile facilities are currently in use for simulating a Protected Loss of Flow Accident (PLOF) for the Gas Cooled Fast Reactor (GCFR) development program. Design activities are currently underway for a test that will employ 438 simulated fuel rods to simulate a hexagonally shaped GCFR core module and its six boundaries. One of the objectives of this series of tests is to demonstrate the behavior of one of the GCFR modules in the event of a loss of coolant flow and subsequent shutdown of the reactor to the power level provided by the decay heat. Another objective is to provide some insight into the structural design for the module by identifying areas for which current designs can be improved. This paper is aimed at describing the analytical tool developments and applications for examining the complex processes of the fluid/thermal/structural interaction of these GCFR experiments. One of the tools that will be described in some detail is the development of an efficient finite element for the thermoelastic moderately large deformation of a a beam column.

34989 (LA-UR—80-2481) **Developmental assessment of the Fort St. Vrain version of the Composite HTGR Analysis Program (CHAP-2).** Stroh, K.R. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 12p. (CONF-800946—5). NTIS, PC A02/MF A01.

From IAEA specialists meeting on gas cooled reactor safety and licensing aspects; Lausanne, Switzerland (1 Sep 1980).

The Composite HTGR Analysis Program (CHAP) consists of a model-independent systems analysis mainframe named LASAN and model-dependent linked code modules, each representing a component, subsystem, or phenomenon of an HTGR plant. The Fort St. Vrain (FSV) version (CHAP-2) includes 21 coded modules that model the neutron kinetics and thermal response of the core; the thermal-hydraulics of the reactor primary coolant system, secondary steam supply system, and balance-of-plant; the actions of the control system and plant protection system; the response of the reactor building; and the relative hazard resulting from fuel particle failure. FSV steady-state and transient plant data are being used to partially verify the component modeling and dynamic smulation techniques used to predict plant response to postulated accident sequences.

34990 (ORNL/TM—7044) **Involvement of the ORNL Chemical Technology Division in contaminated air and water handling at the Three Mile Island Nuclear Power Station.** Brooksbank, R.E.; King, L.J. (comps.). (Oak Ridge National Lab., TN (USA)). Aug 1979. Contract W-7405-ENG-26. 61p. NTIS, PC A04/MF A01.

The President's Commission on the Accident at Three Mile Island requested that Oak Ridge National Laboratory (ORNL) generate documents concerning two areas in which ORNL personnel provided on-site assistance following the accident on March 28, 1979. These are: instrumentation diagnostics, and the treatment of radioactive wastes and liquid effluents stemming from the accident. This report describes the involvement of the ORNL Chemical Technology Division (CTD) in contaminated air and water handling at Three Mile Island (TMI).

34991 (PNL—3259) **COBRA-WC: a version of COBRA for single-phase multiassembly thermal hydraulic transient analysis.** George, T.L.; Basehore, K.L.; Wheeler, C.L.; Prather, W.A.; Masterson, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 317p. NTIS, PC A14/MF A01.

The objective of this report is to provide the user of the COBRA-WC (Whole Core) code a basic understanding of the code operation and capabilities. Included in this manual are the equations solved and the assumptions made in their derivations, a general description of the code capabilities, an explanation of the numerical algorithms used to solve the equations, and input instructions for using the code. Also, the auxiliary programs GEOM and SPECSET are described and input instructions for each are given. Input for COBRA-WC sample problems and the corresponding output are given in the appendices. The COBRA-WC code has been developed from the COBRA-IV-I code to analyze liquid Metal Fast Breeder Reactor (LMFBR) assembly transients. It was specifically developed to analyze a core flow coastdown to natural circulation cooling.

34992 (PNL-SA—8143) **Demonstration of alternative decontamination techniques at Three Mile Island.** Arrowsmith, H.W.; Allen, R.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract AC06-76RL01830. 41p. (CONF-7911104—1). NTIS, PC A03/MF A01.

From DOE/EPRI symposium on Three Mile Island Reactor problems; Harrisburg, PA, USA (11 Nov 1979).

This paper discusses the following decontamination techniques: immersion electropolishing, in-situ electropolishing, barrel electropolishing, vibratory finishing, high-pressure freon spray, centrifugation, acid adsorption, and solidification. (DLC)

34993 **Nuclear cage: reply.** Jones, P.M.S. (UKAEA). *New Statesman;* **99**: No. 2567, 815(30 May 1980).

34994 **Basic principles and results of the German risk study.** Heuser, F.W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)); Bayer, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). *Atomwirtsch., Atomtech.;* **25**: No. 1, 46-51(Jan 1980). (In German).

In June 1976 the Federal Ministry for Research and Technology had commissioned the Gesellschaft fuer Reaktorsicherheit to write the German Risk Study, the first part of which has now been completed after three years of work and has been publicized recently. The German Risk Study is an attempt to define the societal risk posed by accidents in nuclear power plants under conditions in Germany. For this purpose, the accident rates and the resultant health hazards were determined. By adopting most of the basic premises and methods of the American Rasmussen Study, the German study is to allow a comparison to be made with the results of that study. The calculations were based on 19 sites with a total of 25 nuclear generating units presently in operation, under construction or in the licensing procedure in the Federal Republic of Germany. The technical studies were conducted on a 1300 MW PWR as the representative example. The results show that the decisive contributions are made by uncontrolled minor loss-of-coolant accidents and by failures of power supply (emergency power case). Large loss-of-coolant accidents do not play a role. The study also shows the decisive safety function of the containment.

34995 **Sodium spillage in large LMFBRs resulting from slug impact on the reactor cover.** Zeuch, W.R. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.). *Nucl. Eng. Des.;* **55**: No. 2, 207-218(Dec 1979).

From 5. international conference on structural mechanics in reactor technology (SMIRT-5) and 9. international seminar in conjunction with 2. international seminar on structural reliability of mechanical components and subassemblies of nuclear power plants and 2. international seminar on containment of fast breeder reactors; Berlin, Germany, F.R. (9 - 21 Aug 1979).

This study deals with the sodium spillage phenomenon as it relates to accident energetics and containment integrity. Energetic core-disruptive events leading to slug impact could open leak paths in the reactor cover and vent sodium into the secondary containment. Sodium fires in the containment building could lead to pressurization and thermal stressing of the surrounding structure and jeopardize containment integrity. The potential consequences of such a scenario have prompted the development of analytical tools to quantify the spillage process. One of the primary concerns in assessing the integrity of secondary containment is the amount and velocity of sodium which may be ejected from the primary vessel. A parametric study has been performed, the purpose of which was to study the sensitivity of sodium spillage to accident energetics. Treat-

ment of the spillage process was accomplished with the ICECO code employing a quasi-Eulerian method.

ENERGY STORAGE

CAPACITOR BANKS

REFER ALSO TO CITATION(S) 34891

34996 (SAND—80-1809C) **High energy density capacitor program at Sandia National Laboratories.** Mauldin, G.H. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 16p. (CONF-801040—1). NTIS, PC A02/MF A01.

From Symposium on high energy density capacitors; Boston, MA, USA (30 Oct 1980).

The following specific subject areas are discussed: the High Energy Density Capacitor Reliability Assessment Program at Sandia National Laboratories; the Discovery of the Perfect Liquid Impregnant for High Energy Density Capacitors; and the Description of a Production Design Using the New Technology.

FLYWHEELS

34997 (UCRL—15257) **State-of-the-art review of flywheel burst containment.** Sapowith, A.D.; Witmer, E.A.; Gurson, A.L.; McElman, J.A.; Kaehler, H. (Avco Systems Div., Wilmington, MA (USA)). 15 May 1980. Contract W-7405-ENG-48. 108p. NTIS, PC A06/MF A01.

The state-of-the-art of burst containment, primarily for aircraft turbines, is considered and a preliminary evaluation of this state-of-the-art as applied to the burst containment of composite flywheels is presented. Information is included on burst phenomena, ballistic puncture tests, containment materials, failure modes, containment design and strain energy properties. (LCL)

34998 (UCRL—15261) **Flywheel containment technology assessment.** Coppa, A.P.; Zweben, C.H.; Mirandy, L. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 10 Jul 1980. Contract W-7405-ENG-48. 138p. NTIS, PC A07/MF A01.

The need for flywheel containment to protect against excessive damage in the event of flywheel burst or failure was investigated. Modes of rotor failure, the behavior of fragments from metal and composite material rotors, the behavior of materials under impact load, the trade-off between requirements for containment and noise suppression versus the need for minimum weight in vehicular flywheel machinery, and an assessment of current containment technology are discussed. (LCL)

34999 (UCRL—84713) **Flywheel rotor and containment technology development program of the US Department of Energy.** Kulkarni, S.V. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 6 Aug 1980. Contract W-7405-ENG-48. 55p. (CONF-800848—2). NTIS, PC A04/MF A01.

From 3. international conference on composite materials; Paris, France (26 Aug 1980).

The status of the flywheel rotor and containment technology development program in the United States, sponsored by the Department of Energy, is reviewed. The specific objectives of the effort are delineated, and prototype composite rotor designs are described. These prototypes are being evaluated to identify promising designs for future development and end-use applications. The composite-laminated-rotor development effort at Lawrence Livermore National Laboratory (LLNL) and General Electric are also discussed, including design modifications to improve energy density, fabrication of thick composite laminates and filament-wound rings, low-cost manufacturing processes, generation of rotor-design data, nondestructive inspection, and spin testing of rotors. Finally, an assessment is made of the current rotor-burst-containment design philosophy and of the applicability of jet-engine fan-blade containment technology to flywheel systems. Based on this assessment, preliminary design criteria for containment are evolved.

THERMAL

REFER ALSO TO CITATION(S) 34757, 34758, 34759, 34760, 34761, 34762, 34763

CHEMICAL

35000 (DOE/ET/26956—T1) **Thermo-chemical energy conversion and storage. Final report.** Ritter, A.B.; DeLancey, G.B.; Schneider, J.; Silla, H. (Stevens Inst. of Tech., Hoboken, NJ (USA)). Sep 1978. Contract AS02-77ET26956. 24p. NTIS, PC A02/MF A01.

Research support for the cyclohexane/benzene heat pipe development program at Sandia Laboratories is reported. The apparent kinetics of the gas-phase catalytic dehydrogenation of cyclohexane to benzene in an internally recirculated (gradientless) reactor over the temperature range from 500 to 800°F at 1 atm at various space velocities was studied. A kinetic model was developed based on a reversible mass-action rate expression and a catalyst effectiveness factor which is able to correlate both the conversion and reaction rate data very well over the temperature range 500 to 750°F. The data taken at 800°F appear to be qualitatively and quantitatively different than the data taken at the lower temperatures. It is not as yet clear, whether this can be attributed to a change in kinetic mechanism or some reversible alteration of the catalyst surface at the higher temperature. The formation of side products in this system over the same temperature range was also studied. Both the number and amount of side product(s) formed increases with increasing temperature and residence time. Over the temperature range from 500 to 600°F the side products produced appear to be strongly related to the presence of low molecular weight unsaturated hydrocarbon impurities in the (reagent grade) cyclohexane feed and it is possible that no side products would be formed were it not for the presence of these impurities. At temperatures above 600°F, both the number and amount of side product(s) produced increases markedly. A test loop was designed and partially fabricated which will permit the study of the effects of long term continuous cycling of the system on catalyst activity and side product formation.

BATTERIES

REFER ALSO TO CITATION(S) 35116

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 35015

35001 (AD-A—078714/3) **High rate stable nickel-cadmium batteries. Final report Jun 75-May 79.** Hill, J.M. (Eagle-Picher Industries, Inc., Colorado Springs, CO (USA)). Aug 1979. Contract DAAB07-75-C-1770. 67p. NTIS, PC AA04/MF A01.

The report describes work for the design, construction, and testing of advanced state-of-the-art high rate stable vented nickel-cadmium batteries, with a special emphasis on the improvement of the separator wrap. Eagle-Picher Industries, Inc. designed and tested three to five cell units (BB-600 cells) of the BB-433 aircraft battery during phase I of this contract for the purpose of determining and selecting an optimum design. Phase II, the second half of the contract, included the design, fabrication and testing of 24 volt, 35 ampere-hour batteries of the BB-433 configuration, utilizing the optimum design features of Phase I. The batteries and the three to five cell units were tested in accordance with the updated Technical Guidelines for High Rate Stable Nickel-Cadmium Batteries.

35002 (ANL/OEPM—79-12) **Research, development and demonstration of nickel-zinc batteries for electric vehicle propulsion. Annual report, 1979.** (Exide Management and Technology Co., Yardley, PA (USA)). Jun 1980. Contract W-31-109-ENG-38. 110p. NTIS, PC A06/MF A01.

Activities in a program to develop a Ni/Zn battery for electric vehicle propulsion are reported. Aspects discussed include battery design and development, nickel cathode study, and basic electrochemistry. A number of engineering drawings are supplied. 61 figures, 11 tables. (RWR)

PERFORMANCE AND TESTING

35003 (AD-A—078646/7) **Characterization measurements on new nickel/cadmium aircraft batteries manufactured by Marathon and SAFT. Technical note.** Feldman, K.; Verville, G. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1979. 18p. NTIS, PC AA02/MF A01.

A set of measurements has been found useful in the laboratory at DREO for characterizing nickel/cadmium aircraft cells. It is thought such measurements would also be useful in the battery shop to aid in the making of decisions on the need for reconditioning or for discarding cells which are no longer safe or satisfactory. Most of the experience at DREO has, however, dealt with old or rebuilt batteries. Recently one new 22Ah battery from Marathon and two new 36Ah batteries from SAFT were obtained. Results of the measurements on these are therefore of special interest. This paper briefly outlines the measurements and presents the data obtained.

35004 Composition gradients in molten salt binary mixtures during electrolysis at high current density. Vallet, C.E.; Heatherly, D.E.; Braunstein, J. (Oak Ridge Natl Lab, Tenn). *J. Electrochem. Soc.;* **127**: No. 1, 1-7(Jan 1980).

Separation of components has been measured in binary molten salt mixtures, $AgNO_3$-KNO_3, subjected to electrolysis between silver electrodes. The analysis of thin slices of frozen mixture contained in silica frits gives qualitatively the composition changes between anode and cathode and shows the expected enrichment of potassium ions at the cathode. Changes in concentration at the electrodes are measured electrochemically in free electrolytes and in electrolytes contained in frits. The time dependence of concentration at the electrodes is obtained both during electrolysis and during relaxation following electrolyses of different durations. The experimental results confirm the predictions from a mass transport model proposed previously for systems analogous to mixed molten salt batteries operated at high current densities. This work is pertinent to electric batteries. 22 refs.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 35001

35005 (AD-A—078697/0) **Aromatic ions as anode materials for rechargeable, ambient - temperature batteries. Final report.** James, S.D. (Naval Surface Weapons Center, Silver Spring, MD (USA)). 22 Mar 1979. 28p. NTIS, PC AA03/MF A01.

The use of aromatic radical ions is proposed as anode material for high-energy-density, ambient-temperature, secondary batteries. Preliminary data are promising, showing that the naphthalenide anion can provide high current densities at practical current-collectors like steel and nickel. However, the present test-electrode design did not confine naphthalene long enough to demonstrate rechargeability over a number of cycles. Two approaches are recommended to containing the aromatics close to a current-collector for extended periods of charge-discharge cycling.

35006 (BTHE—010098) **Survey of electrical safety requirements for battery chargers in France.** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). 1978. 32p. Price to members $110.00.

The survey outlines the general situation relating to electrical equipment and the particular situation relating to battery chargers in France. The information has been selected from THE's data bank and is believed to be correct at the date shown on the title page. The report is presented in sections as follows: A brief outline of the equipment approval and installation practice; a section entitled 'Organizations and their Functions', itemizing the various authorities either responsible for the issuing of technical requirements or for the enforcing of them; a summary, entitled 'Regulations and Technical Requirements', of the relevant official general national requirements relating to equipment and installations existing; and a schedule giving, in tabular form, the standards, national and international, which are applied in the country for the equipment under review and also to major components thereof. The schudule shows whether approval is 'compulsory' by law or 'voluntary'.

35007 (BTHE—010099) **A survey of electrical safety requirements for battery chargers in Spain.** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). 1978. 22p. Price to members PC $110.00.

The survey outlines the general situation relating to electrical equipment and the particular situation relating to battery chargers in Spain. The information has been selected from THE's data bank and is believed to be correct at the date shown on the title page. The report is presented in sections as follows: A brief outline of the equipment approval and installation practice; a section entitled 'Organizations and their Functions', itemizing the various authorities either responsible for the issuing of technical requirements or for the enforcing of them; a summary, entitled 'Regulations and Technical Requirements', of the relevant official general national requirements relating to equipment and installations existing; and a schedule giving, in tabular form, the standards, national and international, which are applied in the country for the equipment under review and also to major components thereof. The schedule shows whether approval in each country is 'compulsory' by law or 'voluntary'.

35008 (BTHE—010100) **A survey of electrical safety requirements for battery chargers in Sweden.** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). 1978. 27p. Price to members $110.00.

The survey outlines the general situation relating to electrical equipment and the particular situation relating to battery chargers in Sweden. The information has been selected from THE's data bank and is believed to be correct at the date shown on the title page. The report is presented in sections as follows: A brief ouline of the equipment approval and installation practice; a section entitled 'Organizations and their Functions', itemizing the various authorities either responsible for the issuing of technical requirements or for the enforcing of them; a summary, entitled 'Regulations and Technical Requirements', of the relevant official general national requirements relating to equipment and installations existing; and a schedule giving, in tabular form, the standards, national and international, which are applied in the country for the equipment under review and also to major components thereof. The schedule shows whether approval in each country is 'compulsory' by law or 'voluntary'.

35009 Cast-on method and apparatus for casting parts onto the lugs of lead-acid battery plates stacks. Eberle, W.J. (to General Battery Corp.). US Patent 4,180,120. 25 Dec 1979. Filed date 30 May 1978. 12p.

A novel cast-on method and apparatus are disclosed wherein in the preferred embodiment only one major moving part is provided which is indexed through various positions to cast a group or element from a battery plate stack engaged by it. In the preferred embodiment, a mold carriage block having a plurality of mold voids formed through it slidingly reciprocates along a base plate on which are defined fluxing (loading), casting, and part-release positions. In the casting position, lead gravitationally siphons into the mold voids defined in the mold carriage through molten lead supply orifices defined in the base plate along which the carriage slides. Once the casting operation is completed, sliding the carriage out of the casting position effectively seals the molten lead supply orifices. The apparatus and method are particularly suited for use by a single operator who manually loads stacks into the apparatus and subsequently unloads completed groups or elements from the apparatus. 5 figures.

35010 Method and apparatus for rapid battery charging. Samsioe, P.E. US Patent 4,179,648. 18 Dec 1979. Priority date 24 Jan 1977, Sweden, 6p.

A method and apparatus for charging electrical storage batteries having a known nominal amperage are described. The method consists in discharging the battery to a predetermined value and then charging the battery with a charging current initially several times greater than the nominal battery amperage. The charging current decreases exponentially from the initial charging current to a charging current much less than the nominal battery amperage when the battery is fully charged. The apparatus uses the discharge rate of an RC circuit to control the charging current applied to the battery. 3 figures, 1 table.

35011 Dual output battery charging system. Cummins, D.L.; Stahura, D.W. (to General Motors Corp.). US Patent 4,179,647. 18 Dec 1979. Filed date 2 Dec 1977. 10p.

The alternating current output potential of an alternator is rectified by a main rectifier circuit to provide a first charging potential and by an auxiliary rectifier circuit arrangement of the type that is enabled only in response to the presence of electrical enabling signals to provide a second charging potential. The first charging potential is applied across two series-connected storage batteries, and the second charging potential is applied across only a selected one of batteries. The enabling signals for the auxiliary rectifier circuit arrangement are initiated by a free-running oscillator circuit, and circuitry responsive to the potential across the two batteries in series and to the potential across the selected battery is arranged to disable the oscillator circuit when the potential across the selected battery is of magnitude greater than one-half that of the potential across the two series-connected batteries. 1 figure.

35012 Sealed container construction capable of safely venting internal pressure. Rosansky, M.G. (to Power Conversion, Inc.). US Patent 4,175,166. 20 Nov 1979. Filed date 2 May 1978. 6p.

A sealed electrical energy storage container is provided which is cylindrical in shape and has upstanding sidewalls of generally uniform thickness. The upstanding sidewalls of the container include at least one area of reduced sidewall thickness, and the reduced sidewall thickness area is designed to rupture in response to predetermined circumferential stresses occurring within the cylindrical container. The circumferential stresses occurring within the cylindrical container can be calculated, hence the thickness of the reduced thickness area can also be calculated, such that container venting will occur in response to a predetermined internal pressure within the container. 3 figures.

35013 Sodium sulphur cells. Brennan, M.P.J. (to Chloride Silent Power Ltd.). US Patent 4,173,686. 6 Nov 1979. Priority date 19 Sep 1977, United Kingdom of Great Britain and Northern Ireland (UK), 8p.

In a sodium-sulfur cell a cathode current collector, which extends into the cathodic region to provide a high-conductivity current path, is formed of aluminum with a sheath over the surface of the aluminum or with finned elements secured to the aluminum. The sheath or fins are of a corrosion-resistant metal, and are secured to the aluminum by bonding through a protective coating over the surface of the aluminum, which serves to protect the aluminum from the cathodic reactant. 20 claims, 4 figures.

35014 Manufacture of electrodes for electrochemical cells. Henson, K. (to Unigate Ltd.). US Patent 4,166,870. 4 Sep 1979. Priority date 24 Aug 1973, United Kingdom of Great Britain and Northern Ireland (UK), 6p.

A process of manufacturing an electrode for a zinc halogen electric cell comprises the following steps: forming a first mix of 20 to 100 grams of 50% compressed acetylene black, 450 to 750 ml water, about 5 ml acetone, and, if desired, 5 ml of 30% zinc chloride solution by mixing gently; forming a second mix of 50 ml latex and 50 to 250 ml water; adding the second mix slowly to the first mix until the resultant mix is in crumbly form; applying a layer of this crumbly mix to a sheet of expanded anodizable metal or alloy or of including a metal or metals of Group IV(A) or V(A); and pressing the layer on to the metal sheet. 2 figures.

35015 Battery package and assembly. Affolter, P. Matharani, M.A. US Patent Application 14,670. 4 Sep 1979. Filed date 23 Feb 1979. 2p.

Defensive Publication T,986,011.

A battery package includes a plurality of cylindrical cells electrically connected in series and wrapped in a plastic web. The web includes a plurality of adjacent, parallel arches or arcuate sections that conform generally to the cylindrical shape of the cells to constrain the cells in the package in a predetermined relationship. Although the web is somewhat flexible, it provides a generally rigid package when secured around the cells. In one embodiment, a single web engages the cells against a more solid structural piece to define a stable battery structure. In another embodiment the cells are encased in opposed plastic webs, each having a plurality of arches separated by intermediate sections. The opposed webs are then sealed together at the intermediate sections to capture the cells between the arches and to rigidify the overall battery structure. In still another embodiment, two cells, welded together end-to-end, are inserted into a tube of plastic shrink wrap. When the wrap is heated, it contracts around the cells, holding them together in a substantially rigid structure. In at least the first-mentioned of the above embodiments, the web can be used to facilitate handling of a plurality of the multicell batteries during manufacture and storage. Individual batteries would then be cut from the web for use.

ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 35107

35016 (DOE/CA/10879—01) **Consumer Energy Atlas.** (Fraser/Associates, Washington, DC (USA)). Jun 1980. Contract AC03.80IR10879. 265p. NTIS, PC A12/MF A01.

This first edition of the Atlas provides, in reference form, a central source of information to consumers on key contacts concerned with energy in the US. Energy consumers need information appropriate to local climates and characteristics - best provided by state and local governments. The Department of Energy recognizes the authority of state and local governments to manage energy programs on their own. Therefore, emphasis has been given to government organizations on both the national and state level that influence, formulate, or administer policies affecting energy production, distribution, and use, or that provide information of interest to consumers and non-specialists. In addition, hundreds of non-government energy-related membership organizations, industry trade associations, and energy publications are included.

35017 (DOE/CS/30098—01(Vol.2)) **Renewable Resources: a national catalog of model projects. Volume 2. Mid-American Solar Energy Complex Region.** (Center for Renewable Resources, Washington, DC (USA)). Jul 1980. Contract FG01-79CS30098. 444p. NTIS, PC A19/MF A01.

This compilation of diverse conservation and renewable energy projects across the United States was prepared through the enthusiastic participation of solar and alternate energy groups from every state and region. Compiled and edited by the Center for Renewable Resources, these projects reflect many levels of innovation and technical expertise. In many cases, a critique analysis is presented of how projects performed and of the institutional conditions associated with their success or failure. Some 2000 projects are included in this compilation; most have worked, some have not. Information about all is presented to aid learning from these experiences. The four volumes in this set are arranged in state sections by geographic region, coinciding with the four Regional Solar Energy Centers. The table of contents is organized by project category so that maximum cross-referencing may be obtained. This volume includes information on the Mid-American Solar Energy Complex Region. (WHK)

35018 (UCID—18769) **US energy flow in 1979.** Ramsey, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jul 1980. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01.

An energy flow diagram for the US for 1979 is presented. Some significant differences between 1978 and 1979 are: total energy use increased 0.8%; energy imports decreased to 16.7 quads, 3.5% below 1978; natural gas remained more or less constant; coal use increased 11.3%; delivered nuclear power decreased by 7.7% due to the TMI incident and its consequences; and a trend toward electrification continued with distributed electrical energy increasing by 1.9%. While both energy use and gross national product increased, the energy per GNP ratio declined, continuing a trend started in 1971. The lower this ratio is, the more efficiently energy is used in the economy. This ratio now stands at 55.0 thousand Btu per 1972 dollar, down 1.6% from 1978.

35019 Preliminary conceptual review of the New Mexico Energy Management Information System (EMIS). Draft. Sante Fe, NM; New Mexico Energy and Minerals Dept. (1980). 326p. (NP—25103).

The EMIS design described in this document is that which will provide the most cost-effective response to the requirements of primary users for energy data and related services. It will also serve as a prototype system for establishing the commonality of interfaces to be used by state, regional, and national organizations concerned with the collection, analysis, and dissemination of energy information. Energy resources in New Mexico are among the highest in the nation. The EMIS program provides the New Mexico Energy and Minerals Department, and other State of New Mexico executive and legislative agencies, with a reliable and readily available source of base, supplementary, and emergency data essential to the development and management of New Mexico's energy resources. It supports the US DOE in the design, development, test, and implementation of national, regional, and state energy-data programs requiring the collection, validation, analysis, and/or dissemination of energy information at regional, state, or local levels. EMIS also serves as a focal point for the conduct of both long- and short-term analyses of factors affecting New Mexico's energy future - and, most particularly, for the provision of specialized data and analytical support required for the resolution of energy problems of an emergency nature.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 35020, 35021, 35045, 35047, 35052, 35075

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 34551, 34604, 35063, 35071

35020 (DOE/EIA—0184/17) **Projecting marginal energy costs using the Midterm Energy Forecasting System.** Walton, H.; Zalkind, J. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 52p. NTIS, PC A04/MF A01.

A procedure has been incorporated into the Midterm Energy Forecasting System (MEFS) for projecting the marginal costs of producing, processing, converting, and distributing various forms of energy to users in each economic sector and DOE region. These costs are the amounts that consumers in each economic sector would have to pay for an additional unit of a given type of energy if current laws governing the energy markets were to remain in force through 1995. The report describes these procedures and provides sample results consistent with the Projection Series in the EIA's Annual Report to Congress, 1978. MEFS has been programmed to calculate and report marginal energy costs. Coal, oil, and natural gas are reported separately for each economic sector: residential, commercial, industrial, transportation, and raw materials. Electricity is reported two ways: by sector averaged over all categories of load (base, intermediate, and peak-load electricity), and by specific load category averaged over all sectors.

35021 (DOE/EIA—0190) **State energy fuel prices by major economic sector from 1960 through 1977.** Galliker, J.P. (Department of Energy, Washington, DC (USA). Office of Consumption Data System). Jul 1979. Contract AC01-77EI08555. 141p. NTIS, PC A07/MF A01.

The state energy fuel prices are described and displayed by major economic sector for 1960 to 1977. These prices support the Regional Energy Demand Model. The 7 major fuel commodities in the Price Data System fall into two groups: petroleum products (distillate, residual, kerosene, gasoline, and liquid petroleum gas) and non-petroleum product fuels (electric power and natural gas). The methodology for calculating each commodity is shown. A detailed description of the wholesale and retail price methodology is presented. Appendices A and B display the price series in calorific and physical units, respectively. Some data-supporting tables are present-

ed in Appendix C and Appendix D describes the fuel identifiers for decoding information in Appendices A and B.

35022 (PB—80-117922) **Bibliography on the voluntary standards system and product certification. Final report.** Chapman, C.A. (National Bureau of Standards, Washington, DC (USA)). Oct 1979. 29p. NTIS, PC A03/MF A01.

The bibliography lists references accumulated by the NBS Office of Engineering Standards in the course of its research into the working of the voluntary standards system and the economic and legal effects of standards. The first portion of the bibliography lists references alphabetically by author. The second portion groups references by subject. Subject categories include: standards system reform, regulatory use of standards (buildings, safety, environment), certification and laboratory accreditation, solar heating and cooling, product liability, and international and foreign.

35023 (PB—80-119795) **Economic impact analysis of hazardous waste management regulations on selected generating industries. Final report.** (Energy Resources Co., Inc., Cambridge, MA (USA)). Jun 1979. Contract EPA-68-01-4819. 513p. NTIS, PC A22/MF A01.

The report estimates the economic impact of three RCRA Subtitle C regulatory options for potentially hazardous wastes from selected industries. The industries selected were: electric utilities, pulp and paper, gasoline service stations, drum reconditioners, chemical wholesaling, agricultural services and metal and mineral distributors. Estimates of compliance costs, change in net income, plant closures, production losses, job losses, and price increases are provided for each of these industries under each of the regulatory options.

35024 (NP—24990) **State and industry: the example of energy.** (Sozialistische Jugend Deutschlands - Die Falken, Gelsenkirchen (Germany, F.R.). Landesverband Nordrhein-Westfalen). [nd]. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01.

In three seminars with lectures and films, theories of the state were discussed using the example of the multinational energy companies. An attempt is made to visualize the role of the national states with regard to these undertakings and the mutual interdependences, mostly from a Marxist point of view.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 34556, 34559, 35023, 35383, 35384, 35385, 35386, 35387

35025 (BNL—51041) **Use of county level data in health, energy, demographic, environmental, and economic analysis.** Morris, S.C.; Novak, K.M.; Calef, C.E. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1979. Contract AC02-76CH00016. 160p. (CONF-7703137—). NTIS, PC A08/MF A01.

From Computer based conference; Upton, NY, USA (4 Mar 1977).

This document is an edited record of the conversation, dialogues, and topical discussions of the participants of a computer conference sponsored by the Biomedical and Environmental Assessment Division of Brookhaven National Laboratory during the period March 4-28, 1977. The main objective of the conference was to bring together a number of individual specialists from a wide and diverse range of both academic and professional disciplines to address the usage of county level data in health, energy, demographic, environmental, and economic analysis. A secondary aim of the conference was to test the feasibility and viability of using a computer conference as a means of accomplishing our primary objective. A preface, a list of participants, and the transcript of the main conference and subsession proceedings are included. Also included are information provided by participants on the identification of intercensal county equivalent areas and additional reports and documents relevant to the conference topic. The overall aims and objectives of the conference were successfully accomplished; some of the problems encountered using the computer as a conference vehicle were noted; recommendations were made to continue both formal and informal lines of communication on the subject of county level data.

35026 (BNL—51170) **Staff rosters for 1979: environmental programs.** (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract AC02-76CH00016. 99p. NTIS, PC A05/MF A01.

The roster of the scientific and professional staffs of the Environmental Programs of the Department of Energy and Environment has been compiled as of December 1979. Staff members have been listed according to their organizational units, i.e., the Atmospheric Sciences Division, the Environmental Chemistry Division, the Oceanographic Sciences Division, and the Land and Freshwater Environmental Sciences Group. Educational background, research interests, professional activities, summary of experience at BNL, and selected publications have been included for each member listed.

NATURAL RESOURCES

35027 (PB—80-102619) **Technical options for conservation of metals. Case studies of selected metals and products.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1979. 128p. NTIS, PC A07/MF A01.

The shortages in many critical metals and other materials that the United States has experienced in recent years, along with its increasing dependence on foreign sources of supply for those materials has intensified interest in the prospects for making less wasteful and more efficient use of materials. This study explores the kinds and amounts of waste that occur in this Nation's use of eight critical metals and the technical options for reducing that waste. The eight metals studied are: iron, copper, aluminum, manganese, chromium, nickel, tungsten, and platinum. In their levels of import dependence and in other respects, these metals are a representative sample of commercially important metals. This study was requested by the Committee on Commerce, Science and Transportation of the US Senate.

35028 (PB—80-110828) **Stanislaus River drainage basin and the New Melones Dam: historical evolution of water use priorities.** Jackson, W.T.; Mikesell, S.D. (California Univ., Davis (USA). Water Resources Center). Jun 1979. 193p. NTIS, PC A09/MF A01.

The evolution of water use priorities for the Stanislaus River goes beyond the highly-publicized contest of the 1970s between the federal water agencies and the environmentalists over construction of the New Melones project. Since the 1850s, plans for development of the Stanislaus River have passed through several distinct phases, each reflecting the prevailing values and objectives. These phases, analyzed topically and chronologically in this report, include: a private phase, dominated by mining-related and subsequently by the electric utility interests; a local phase, dominated by irrigation districts, culminating in construction of the Tri-Dam Project in the late 1950s; and an early federal phase, in which the Bureau of Reclamation and the Corps of Engineers competed for jurisdiction for the New Melones Dam.

35029 (PB—80-113145) **National water assessment (1975): Upper Colorado Region. Specific problem analysis state/regional future. Technical memorandum No. 2.** (Water Resources Council, Washington, DC (USA)). Aug 1976. 129p. NTIS, PC A07/MF A01.

Regional sponsors in cooperation with the Water Resources Council, surveyed and analyzed State and Regional viewpoints on current and future water problems. The region studied comprises the Upper Colorado River Basin, and includes the states of Colorado, New Mexico, Utah, and Wyoming.

35030 (PB—80-113699) **Alaska water assessment: problem information. Technical memorandum No. 3.** (Water Resources Council, Washington, DC (USA)). Dec 1976. 103p. NTIS, PC A06/MF A01.

Regional sponsors, in cooperation with the Water Resources Council, surveyed and analyzed State and regional viewpoints on current and future water problems. The problem area surveyed is the state of Alaska.

35031 (PB—80-113723) **Great Basin Region water assessment (1975). Technical memorandum No. 3. Problem effects.** (Water Resources Council, Washington, DC (USA)). Apr 1977. 112p. NTIS, PC A06/MF A01.

Regional sponsors, in cooperation with the Water Resources Council, surveyed and analyzed State and regional viewpoints on current and future water problems. The problem area surveyed includes part of the states of Idaho, Utah, Wyoming, and Nevada.

35032 (PB—80-119977) **National assessment (1975) California-South Pacific Region 18. Technical memorandum number 2. Activity two-state regional future.** (Water Resources Council, Washington, DC (USA)). Jul 1976. 217p. NTIS, PC A10/MF A01.

Regional sponsors, in cooperation with the Water Resources Council, surveyed and analyzed State and Regional viewpoints on current and future water problems. The problem area surveyed was the state of California.

35033 (PB—80-120983) **National assessment of water and related land resources (1975). Volume III, Appendix D. Specific problem analysis. Activity three. Technical memorandum 3. South Atlantic-Gulf Water Resources Region.** (Water Resources Council, Washington, DC (USA)). Dec 1977. 603p. Water Resources Council, Washington, DC.

Regional sponsors, in cooperation with the Water Resources Council, surveyed and analyzed State and regional viewpoints on current and future water problems. The problem areas surveyed include parts of the states of North and South Carolina, Georgia, Alabama, Mississippi, and Florida.

35034 (PB—80-125347) **Primary water resources data-base for the Second National Water Assessment (magnetic tape documenta-**

tion). **Final report.** (Water Resources Council, Washington, DC (USA)). Dec 1978. 68p. NTIS, PC A04/MF A01.

The Second National Water Assessment by the U.S. Water Resources Council presents a comprehensive nationally consistent data base for the 21 water resources regions of the United States, published in report format in four volumes as 'The Nation's Water Resources--1975-2000' (December 1978, through GPO). The magnetic tape contains much of the data presented in 'Volume 3, Analytical Data.' Information is presented not only for the 21 water resources regions, but for 106 water assessment subregions that provide more localized information. Information is presented for present (1975) and future (1985 and 2000) conditions.

35035 Federal funding in materials research. Ling, J.G.; Hand, M.A. *Science;* **209**: 1203-1207(12 Sep 1980).

The performance of the 20 materials research laboratories (MRL's) at universities funded with institutional grants by the National Science Foundation, Department of Energy, and National Aeronautics and Space Administration is evaluated in comparison with 15 other universities (non-MRL's) receiving individually funded projects for materials research. Performance is measured by peer review and citation frequency analysis of publications, subjective evaluation of research achievements and researcher reputaton by a panel of experts, review of equipment purchases and utilization, and analysis of administrative costs. The study concludes that there are no significant differences between the MRL's and non-MRL's with respect to innovation, interdisciplinarity, utilization of specialized equipment, concentration of funding, rate of turnover, duration of research areas, and level of effort per research paper. The MRL's have a greater number of major achievements and attract researchers with higher reputations. The MRL's tend to emphasize experimental work, and in about 70% of the materials research areas sponsored by the National Science Foundation there is no overlap between the two groups. Institutional grants involve much less total (Federal plus university) administrative cost per grant dollar than project grants.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 35035, 35050

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 34596, 34901, 34927, 34934, 34993, 34994, 35813

35036 Nuclear Energy in France. Anon. *World Sci. News;* **17**: No. 4, 6-12(Jan 1980).

Progress of electricity generation from nuclear energy in France is described in brief and future programmes are outlined. From the net installed capacity of 2,890 MWe by the end of 1975, nuclear power generation is expected to rise to 20,000 MWe by the end of 1980. The emphasis has shifted to the PWR type light water reactor systems for future planning from the earlier graphite gas reactor system. One breeder is already in operation.

35037 (INIS-mf—5693) **Power generation costs. Coal - nuclear power. Comparing investment and operating costs of coal-fired and nuclear power plants. Supplement volume.** (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). 1979. 224p. (In German). NTIS (US Sales Only), PC A10/MF A01.

This supplement volume contains 17 separate chapters investigating the parameters which determine power generation costs on the basis of coal and nuclear power and a comparison of these. A detailed calculation model is given. The complex nature of this type of cost comparison is shown by a review of selected parameter constellation for coal-fired and nuclear power plants. The most favourable method of power generation can only be determined if all parameters are viewed together. One quite important parameter is the load factor, or rather the hours of operation. (UA) 891 UA/UA 892 AMO.

35038 Nuclear power in the Soviet bloc. Ivan 'fisions' while the West burns. *Vector (Johannesburg);* 36-38(Mar 1980).

The USSR has an energy program worked out and running. Soviet nuclear power plants are commissioned at the rate of 2 GW/year. This is expected to rise to 5-8 GW/year by 1990 and to 10 GW/year by the turn of the century. This article discusses the Eastern block program on nuclear power.

35039 Nuclear power and the problems of its development. Nevskii, V.P. *Teploenergetika (Moscow);* No. 12, 4-7(Dec 1979). (In Russian).

The state and prospects of nuclear power in the Soviet Union are considered. Problems of NPP exploitation are discussed, as well as ways of improving the organization of timely and qualitative putting NPP into operation. The main problem of a wide programme of NPP construction is to provide NPP security, reliability and effectiveness. This can be provided by exploiting highly reliable technological equipment and taking appropriate measures during NPP designing, construction and exploitation. One of the main ways to solve these problems is to increase the automation level, to improve control and to provide a gradual transfer from the automation of separate processes to the creation of automatic all-regime NPP control systems.

35040 Report of the Nuclear Energy Section Meeting, General Survey Committee. Okamura, S. (Agency of Natural Resources and Energy, Tokyo (Japan)). *Denki Kyokai Zasshi;* No. 664, 31-35(Feb 1979). (In Japanese).

The demand and supply of petroleum have relaxed temporarily, but in the long run, the difficulty of energy problem does not change. More powerful promotion of general energy policy with conformity and effectiveness is a worldwide problem. In order to cope with such situation, General Energy Survey Committee has examined the concrete measures, and drawn up the interim report in August, 1977. The present report does not change from the interim report in its basic framework, but the background on which this framework is based is clarified, and the contents of the concrete measures are examined in more detail. The Nuclear Energy Sectional Meeting has obtained the conclusions about the basic matters in the development and utilization of nuclear energy and the concrete measures required to be taken urgently. The domestic and foreign situations about the development and utilization of nuclear energy are explained, and the location of nuclear power stations is the most serious bottleneck, therefore the measures to obtain national consensus are the most important problem in every country. The nuclear power generation in Japan is expected to reach 33 million kW by 1985 and 60 million kW by 1990. As the concrete measures, improvement of safety and reliability, establishment of nuclear fuel cycle, development and adoption of new type nuclear reactors, strengthening of the base of nuclear energy industries, promotion of research and development, and contribution to international activities are briefly discussed.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 34519

35041 (DOE/EIA/10617—T1) **Capital requirements for the transportation of energy materials: 1979 ARC estimates. Draft final report.** (TERA, Inc., Arlington, VA (USA)). 13 Aug 1980. Contract AC01-80EI10617. 153p. NTIS, PC A08/MF A01.

This report contains TERA's estimates of capital requirements to transport natural gas, crude oil, petroleum products, and coal in the United States by 1990. The low, medium, and high world-oil-price scenarios from the EIA's Mid-range Energy Forecasting System (MEFS), as used in the 1979 Annual Report to Congress (ARC), were provided as a basis for the analysis and represent three alternative futures. TERA's approach varies by energy commodity to make best use of the information and analytical tools available. Summaries of transportation investment requirements through 1990 are given. Total investment requirements for three modes (pipelines, rails, waterways and the three energy commodities can accumulate to a $49.9 to $50.9 billion range depending on the scenario. The scenarios are distinguished primarily by the world price of oil which, given deregulation of domestic oil prices, affects US oil prices even more profoundly than in the past. The high price of oil, following the evidence of the last year, is projected to hold demand for oil below the recent past.

35042 (PNL-SA—7322) **Environmental concerns influencing the future development of energy material transportation systems: the year 2000 study.** DeSteese, J.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract AC06-76RL01830. 11p. (CONF-7811174—1). NTIS, PC A02/MF A01.

From US DOE environmental control symposium; Argonne, IL, USA (28 Nov 1978).

This paper presents results of studies conducted to assess the potentially longer-range problems which could hinder the future development of safe and environmentally-acceptable energy material transportation systems. The purpose of this effort is to recommend appropriate action that contributes to the anticipatory management of possible future problems before they can have serious effects on the adequacy or acceptability of the system. Most significant future concerns in energy material transportation relate to potential institutional, legal, political and social problems. Environmental issues are involved in many of these concerns. Selected environmental concerns are discussed that may influence the future development of

transportation systems for fossil and nuclear energy materials during the balance of this century. A distinction between potentially real and perceived concerns is made to emphasize basic differences in the recommended approach to solutions of the respective type of potential problem.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 35100

CONSERVATION

REFER ALSO TO CITATION(S) 35065, 35075, 35077, 35078, 35081, 35090, 35091, 35098, 35105, 35106

35043 (EMD—80-82) **Energy conservation: an expanding program needing more direction.** (General Accounting Office, Washington, DC (USA)). 24 Jul 1980. 17p. GPO.

Report to the Secretary of Energy by the US General Accounting Office.

This GAO evaluation report says that DOE's failure to establish overall energy-conservation goals and to develop and implement a comprehensive, coordinated national energy-conservation plan in support of those goals continues to perpetuate confusion over: (1) how much energy conservation is needed; (2) how well the Nation is doing in its conservation efforts; and (3) what more needs to be done over time to realize energy conservation's contribution in solving national energy problems. GAO believes that the opportunity to develop an aggressive, effective conservation strategy for the Nation should not continue to slip away. Accordingly, this report makes several suggestions to the Secretary of Energy on establishing conservation goals and developing a plan to meet such goals.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 34525, 34547, 34566, 35019, 35075, 35125

35044 (CONF-800383—) **DOD-DOE Workshop on Joint Energy Activities.** (Department of Energy, Washington, DC (USA). Office of Energy Research). 1980. 113p. NTIS, PC A06/MF A01.

From DOD-DOE workshop on joint energy activities; Gaithersburg, MD, USA (10 Mar 1980).

The general conditions for DOD-DOE interactions were delineated in an October 1978, Memorandum of Understanding (MOU) that identified two basic goals: improving energy efficiency and availability within DOD, and utilizing DOD and DOE expertise and facilities to carry out projects of mutual interest. There has been considerable interaction between DOD and DOE, including a number of proposed joint initiatives but a systematic and coordinated approach for nurturing, maintaining, and expanding these relationships has not been developed. A DOD-DOE Workshop on Joint Energy Activi ies was held on March 10-12, 1980. The workshop was structured into five working groups - Mobility Fuels, Conservation, Fossil Fuels for Fixed Facilities, Solar and Renewable Energy Sources, and Special Projects - with DOD and DOE cochairmen for each. Over a hundred DOD and DOE management, program, and policymaking representatives were brought together by the workshop Steering Committee to identify specific programs for inclusion in an overall plan for implementing the MOU and to deal with fundamental issues and problems of maintaining future communications. The workshop accomplished its goals, these being to: (1) improve communication among the appropriate key DOD and DOE personnel at all levels and promote information exchange; (2) review ongoing and already-proposed joint DOD and DOE programs; (3) initiate a coordinated, systematic effort to establish joint DOD-DOE energy-security programs; and (4) propose specific programs and projects of mutual interest for inclusion in a follow-on joint-implementation plan.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 34549, 34561, 34605, 34613, 34614, 35022, 35024, 35044, 35065

35045 (BNL—28154) **Experiment in multiple-criteria energy policy analysis.** Ho, J.K. (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. Contract AC02-76CH00016. 18p. (CONF-800847—1). NTIS, PC A02/MF A01.

From International conference on multiple criteria decision making; Newark, DE, USA (11 Aug 1980).

An international panel of energy analysts participated in an experiment to use HOPE (holistic preference evaluation): an interactive parametric linear-programming method for multiple-criteria optimization. The criteria of cost, environmental effect, crude oil, and nuclear fuel were considered according to BESOM: an energy model for the US in the year 2000.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 35063

COAL

REFER ALSO TO CITATION(S) 34465, 34466, 34508, 34509, 34519, 34520, 34522, 34523, 34524, 34525

PETROLEUM

REFER ALSO TO CITATION(S) 34541, 34547, 34549, 34550, 34551, 34552, 34556, 34559, 34561, 35476

NATURAL GAS

REFER ALSO TO CITATION(S) 34565, 34566, 34567, 34568, 35476

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 34579, 34582

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 34618, 34619

ELECTRIC POWER

REFER ALSO TO CITATION(S) 34887, 35063

35046 (DOE/CS/10045—T1) **Choosing an electrical energy future for the Pacific Northwest: an Alternative Scenario.** Cavanagh, R.C.; Mott, L.; Beers, J.R.; Lash, T.L. (Natural Resources Defense Council, Inc., San Francisco, CA (USA)). Aug 1980. Contract FG03-79CS10045. 328p. NTIS, PC A15/MF A01.

An Alternative Scenario for the electric energy future of the Pacific Northwest is presented. The Scenario includes an analysis of each major end use of electricity in the residential, commercial, manufacturing, and agricultural sectors. This approach affords the most direct means of projecting the likely long-term growth in consumption and the opportunities for increasing the efficiency with which electricity is used in each instance. The total demand for electricity by these end uses then provides a basis for determining whether additional central station generation is required to 1995. A projection of total demand for electricity depends on the combination of many independent variables and assumptions. Thus, the approach is a resilient one; no single assumption or set of linked assumptions dominates the analysis. End-use analysis allows policymakers to visualize the benefits of alternative programs, and to make comparison with the findings of other studies. It differs from the traditional load forecasts for the Pacific Northwest, which until recently were based largely on straightforward extrapolations of historical trends in the growth of electrical demand. The Scenario addresses the supply potential of alternative energy sources. Data are compiled for 1975, 1985, and 1995 in each end-use sector.

35047 (DOE/EIA/06242—T1) **Capacity-expansion planning under uncertainty in the electric-utility industry.** Soyster, A.L. (Systemetrics, Inc., Blacksburg, VA (USA)). 25 Jul 1980. Contract AC01-78ET06242. 103p. NTIS, PC A06/MF A01.

This document basically represents a comparison between theory and practice of capacity-expansion planning in the electric-utility industry. The purpose of the comparison is to provide avenues for further exploration in utility decision making. The focus of the Phase II study is upon the role of uncertainty in the decision-making process. The Phase I effort was directed at modeling the Averch-Johnson theory of the regulated utility. Part I of this report reviews the Anderson study (D. Anderson, Models for Determining Least-Cost Investments in Electricity Supply). The Anderson paper has become a standard reference for capacity-planning studies in the electric-utility industry. Part II examines uncertainty and the behavior of the firm. Part III reviews 5 models of electric-utility capacity planning under uncertainty, and Part IV is concerned with capacity-planning models in practice.

35048 (EPRI-EA—1321) **Forecasting residential electric loads with time-of-day rates. Final report.** (Charles River Associates, Inc., Boston, MA (USA)). Aug 1980. 136p. NTIS, PC A07/MF A01.

A model is developred and applied to predict daily and hourly residential electricity demand, allowing for the effect of time-of-day rates. The model structure was developed to allow maximum generalization of results from time-of-day rate experiments and to allow reestimation with new experimental data as they become available. The model structure reflects a two-stage process: consumers first choose the level of expenditure on daily consumption of electricity as a function of an index of the price of electricity and the price of related goods; then the expenditure is allocated to different time periods within the day. The model is estimated and evaluated using data from the Connecticut Peak Load Pricing Experiment. Although the nature of the data imposed limitations on the model, the estimated demand equations generally yielded acceptable statistical results. The model is evaluated by comparing forecasts for 20 observed households with actual demand measured for these households. Since the validation database is relatively small, this validation exercise probably represents an overly restricted test of forecasting capability. Even so, the results of this validation exercise indicate an acceptable level of forecasting accuracy.

35049 (LCD—80-32) **TVA needs to improve management of power stores inventories.** (General Accounting Office, Washington, DC (USA)). 25 Jan 1980. 18p. General Accounting Office, Washington, DC.

Weaknesses in the Tennessee Valley Authority's management of material inventories used to support the production and distribution of electrical power have resulted in a substantial accumulation of excess material. The investment in unneeded inventory and the related inventory holding costs can be reduced if material management organizational structure, policies, and procedures are strengthened.

35050 (PB—80-118912) **Research and development for the electric utility industry, 1975-2000.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). Oct 1974. 169p. NTIS, PC A08/MF A01.

The Technical Advisory Committee on Research and Development was established to recommend research and development to be performed in support of the nation's electric utility industry for inclusion in the 1974 National Power Survey of the Federal Power Commission. The Committee was supported by Task Forces on Energy Sources Research, Energy Conversion Research, Energy Distribution Research, Energy Environmental Research, and on Energy Systems Research. The Task Forces' reports are included, in synopses, in this volume. R and D headlines are presented in the form of 11 brief position papers on important topics such as: the role of research and development in meeting national energy problems; the division of responsibilities for electrical energy research and development; the Federal Power Commission and national energy research and development policy; critical research needs related to conflict resolution in energy decision making; critical research needs on factors determining the demand for energy; energy conservation in large complexes; research needs for energy use and conservation in transportation; the development of intermediate Btu Gas from coal technology; and ultimate non-fossil fuel economy; critical research needs on the environmental impact of energy use; and safety issues of nuclear power. Each headline paper presents the policy issue and technical problem of concern to the Committee followed by its recommendations.

35051 (PB—80-127392) **The effect of regulation on production costs and output prices in the private electric utility industry.** Petersen, H.C. (Stanford Univ., CA (USA). Center for Research in Economic Growth). Sep 1973. 108p. NTIS, PC A06/MF A01.

Private electric utilities in the U.S. are regulated on a rate of return on capital in order to reduce the price consumers pay for power. The study provides evidence regarding the quantitative effect of rate of return regulation by investigating the effect of regulation on the final price of output and on the costs of production. Three measures of allowed returns are developed using two different data sets. Evidence with regard to price shows that as the allowed return is reduced, prices go up and quantity goes down. Conclusions are not favorable to regulation as it presently exists. A simultaneous equation model of production and pricing in the private electric power industry is included.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 34624

35052 (CONS—8138-T2) **Powerplant productivity improvement study: demonstration of the DOE/MRI methodology. Final report.** (Trident Engineering Associates, Inc., Annapolis, MD (USA)). 17 Nov 1978. Contract EM-77-F-01-8138. 379p. NTIS, PC A17/MF A01.

A methodology, distributed by DOE, may be used as a potential tool for the utility industry to assess and evaluate productivity and reliability problems of existing and future units. The model can be used to assess the impact of an improvement project or corrective action on unit productivity parameters such as heat rate, capacity factor, availability, or equivalent availability. The methodology analyzes: the effect of component redundancy on unit equivalent availability; the effect of component reliability on unit equivalent availability; and a component's outage trend to project the component's future outage rate. The first purpose of this study is to illustrate for the utilities how to apply the methodology. Thus, this report contains the analysis performed by applying the methodology at three units of Illinois power plants. The units evaluated were Wood River 5, Quad Cities 1, and Quad Cities 2. A total of 8 improvement projects were evaluated and all outage data and equations used are included in order to facilitate utility reproduction of the given results. The second purpose is to evaluate the methodology as a useful tool for individual utilities; a number of modifications are suggested.

35053 (EPRI-CS—1432) **Resource handbook for power plant training programs. Research Project 1266-6.** Hull, D.M.; Rinard, B.F. (Center for Occupational Research and Development, Waco, TX (USA)). Aug 1980. 608p. NTIS, PC A99/MF A01.

This Resource Handbook represents an initial attempt to catalog available training material which is relevant to coal-fired power plant job categories. Introductory sections provide background information and guidance for using the handbook. Material specifically related to the jobs of Instrument and Control Technician, Environmental and Chemical Analysis Technician, and Power Plant Operator is categorized as Printed Material, Audio/Visual Aids, and Specialty and Packaged Programs. Other sections of the Handbook list organizations supplying material for review, sources having information retrieval capabilities, and professional and trade associations.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 35080

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 35046

35054 (DOE/CS/30098—01(Vol.1)) **Renewable Resources: a national catalog of model projects. Volume 1. Northeast Solar Energy Center Region.** (Center for Renewable Resources, Washington, DC (USA)). Jul 1980. Contract FG01-79CS30098. 414p. NTIS, PC A18/MF A01.

This compilation of diverse conservation and renewable energy projects across the United States was prepared through the enthusiastic participation of solar and alternate energy groups from every state and region. Compiled and edited by the Center for Renewable Resources, these projects reflect many levels of innovation and technical expertise. In many cases, a critique analysis is presented of how projects performed and of the institutional conditions associated with their success or failure. Some 2000 projects are included in this compilation; most have worked, some have not. Information about all is presented to aid learning from these experiences. The four volumes in this set are arranged in state sections by geographic region, coinciding with the four Regional Solar Energy Centers. The table of contents is organized by project category so that maximum cross-referencing may be obtained. This volume includes information on the Northeast Solar Energy Center Region. (WHK).

35055 (DOE/CS/30098—01(Vol.3)) **Renewable Resources: a national catalog of model projects. Volume 3. Southern Solar Energy Center Region.** (Center for Renewable Resources, Washington, DC (USA)). Jul 1980. Contract FG01-79CS30098. 779p. NTIS, PC A99/MF A01.

This compilation of diverse conservation and renewable energy projects across the United States was prepared through the enthusiastic participation of solar and alternate energy groups from every state and region. Compiled and edited by the Center for Renewable Resources, these projects reflect many levels of innovation and technical expertise. In many cases, a critique analysis is presented of how projects performed and of the institutional conditions associated with their success or failure. Some 2000 projects are included in this compilation; most have worked, some have not. Information about all is presented to aid learning from these experiences. The four volumes in this set are arranged in state sections by geographic region, coinciding with the four Regional Solar Energy Centers. The table of contents is organized by project category so that maximum cross-referencing may be obtained. This volume

includes information on the Southern Solar Energy Center Region. (WHK)

35056 (DOE/CS/30098—01(Vol.4)) **Renewable Resources: a national catalog of model projects. Volume 4. Western Solar Utilization Network Region.** (Center for Renewable Resources, Washington, DC (USA)). Jul 1980. Contract FG01-79CS30098. 542p. NTIS, PC A23/MF A01.

This compilation of diverse conservation and renewable energy projects across the United States was prepared through the enthusiastic participation of solar and alternate energy groups from every state and region. Compiled and edited by the Center for Renewable Resources, these projects reflect many levels of innovation and technical expertise. In many cases, a critique analysis is presented of how projects performed and of the institutional conditions associated with their success or failure. Some 2000 projects are included in this compilation; most have worked, some have not. Information about all is presented to aid learning from these experiences. The four volumes in this set are arranged in state sections by geographic region, coinciding with the four Regional Solar Energy Centers. The table of contents is organized by project category so that maximum cross-referencing may be obtained. This volume includes information on the Western Solar Utilization Network Region. (WHK)

SOLAR

REFER ALSO TO CITATION(S) 34660, 34663, 34677, 34681, 34705, 34725, 34758

GEOTHERMAL

REFER ALSO TO CITATION(S) 34764, 34770, 34797, 34798, 34799, 34800, 34801, 34802, 34808

OTHER

REFER ALSO TO CITATION(S) 34864

ENERGY CONVERSION

ENERGY CONVERSION

MHD GENERATORS

35057 (DOE/NASA/2674—12) **Rapporteur report: mhd electric power plants.** Seikel, G.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract AI01-77ET10769. 19p. (NASA-TM—81554; CONF-800617—7). NTIS, PC A02/MF A01.

From 7. international conference on MHD electrical power generation; Cambridge, MA, USA (16 Jun 1980).

Five US papers dealing with MHD electric power plants from the Proceedings of the Seventh International Conference on MHD Electrical Power Generation, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA, June 16-20, 1980, are summarized. The first two of the papers report on the results of the initial Parametric phase of the US effort on the Study of Potential Early Commercial (PSPEC) MHD plants. The third, fourth, and part of the first paper deal with aspects of the smaller commercial prototype plant termed the Engineering Test Facility (ETF). The fifth paper addresses the alternative of using a disk geometry generator rather than a linear generator in baseload MHD plants. It is the only paper that addresses closed-cycle as well as open-cycle MHD plants.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 35183

35058 (AD-A—078865/3) **Magnetohydrodynamic (mhd) magnet modeling. Interim technical report mar-sep 78.** Stekly, Z.J.J.; Pillsbury, R.D. Jr; Beckwith, A.R.; Holmes, R.D. (Magnetic Corp. of America, Waltham, MA). Jun 1979. Contract F33615-77-C-3117. 225p. NTIS, PC AA10/MF A01.

This report presents the results of a study to establish scaling criteria for a lightweight, superconducting magnet system for use in magnetohydrodynamic power generation. The scaling criteria are used to determine the appropriate size for a model magnet to be built to demonstrate the major system parameters of a full scale, 30 MWe, magnet system. (Author)

FUEL CELLS

PERFORMANCE AND TESTING

35059 (DOE/METC/RI—80/17) **Effects of several trace contaminants on fuel cell performance.** Park, S.M.; O'Brien, T.J. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry; Department of Energy, Morgantown, WV (USA). Morgantown Energy Research Center). 1979. 27p. NTIS, PC A03/MF A01.

The electrochemical reactivity of various trace contaminants in coal gas, i.e., Hg/HgS, PbS, CdS, Sn/$SnCl_2$/$SnCl_4$, and TiO_2, in coal gas at the nickel anode and the nickel oxide cathode in a molten carbonate fuel cell have been examined thermodynamically. Calculations indicate that only $SnCl_4$ would undergo reduction at the cathode to $SnCl_2$. Other species would remain intact. Contaminants such as H_2S/SO_2 and HCl have also been included in the calculation. The results are consistent with the limited observations. Possible chemical interactions between contaminants and electrodes or electrolytes have been examined. Reactions of Sn^{2+}, HgS, H_2S, and HCl with the nickel anode have negative free energies. Mercury would interact physically with the anode by forming an alloy. Reactions of Sn, $SnCl_2$, H_2S, and HCl with the nickel oxide cathode also have negative free energies. Reactions of Sn^{2+}, HCl, H_2S, and SO_2 with carbonates have large negative free energies. Born's model of ion transfer was used to calculate the free energy change for the transfer of ions from aqueous solution to the molten carbonate solution.

MATERIALS, COMPONENTS, AND AUXILIARIES

35060 (AD-A—078473/6) **The preparation of some novel electrolytes: synthesis of partially fluorinated alkanesulfonic acids as potential fuel cell electrolytes. Final technical report.** Bunyagidj, C.; Pietrowska, H.; Aldridge, M.H. (American Univ., Washington, DC). Sep 1979. Contract DAAK70-77-C-0047. 77p. NTIS, PC AA05/MF A01.

The objective of this research was to prepare some strong acids for evaluation by Fort Belvoir as potential fuel cell electrolytes. The major acid, other than phosphoric, H^3PO^4, currently under investigation by Fort Belvoir as a fuel cell electrolyte is TFMSA, $CF^3SO^3H.H_2O$, trifluoromethanesulfonic acid monohydrate aqueous solutions and sodium salt mixtures. TFMSA has been found to be superior to H^3PO^4 from the standpoint of electrode kinetics, but certain undesirable characteristics (volatility; wetting of Teflon) led to this research for a better fuel cell electrolyte.

35061 (EPRI-EM—1487) **Assessment of fuel processing systems for dispersed fuel cell power plants.** Minet, R.G.; Warren, D.; Tomita, T.; Hirokawa, K.; Osaki, K.; Shinjo, T. (Kinetics Technology International Corp., Pasadena, CA (USA)). Aug 1980. 132p. NTIS, PC A07/MF A01.

Fuel Cell Power Plant systems capable of using light hydrocarbon gaseous or liquid fuels with low sulfur content are currently entering the demonstration stage. In a previous study consideration was given to the extension of the range of applicable fuels to include heavier hydrocarbon distillates, such as No. 2 fuel oil, by use of a Hybrid reformer system which combined a high temperature steam reformer (HTSR) with an auto thermal reformer (ATR), both of which used sulfur tolerant catalysts. The objective of this report is to analyze the results of bench scale reforming tests of No. 2 fuel oil using sulfur-tolerant reforming catalysts and to present the comparative economics for use of such a catalyst in a Hybrid reformer train and a regenerative type HTSR alone. The sulfur tolerant catalyst system, which is under development as part of Toyo Engineering Corporation's Total Hydrocarbon Reforming (THR) Process, was tested over a wide range of conditions using No. 2 fuel oils of different sulfur and aromatic content. Tests were carried out using a regenerative-type reformer tube as well as a conventional, single-pass tube. The report reviews the experimental results, correlates the data and develops preliminary design parameters for this catalyst. In addition, the catalyst limitations and the requirements of the reformer trains to integrate efficiently with the fuel cell are outlined. Estimates are presented for two fuel processing trains for a nominal 4.8 MW fuel cell power plant: a regenerative type HTSR and a Hybrid system using a regenerative HTSR in a combination with an ATR. It is concluded that the sulfur-tolerant catalyst system is compatible with the process conditions attainable in both a regenerative HTSR alone, and in a Hybrid system, with the latter permitting much wider process limits, to approximate the required efficiency standard (9000 Btu/kWh) desired in a integrated fuel cell system.

35062 **Porous electrolyte retainer for molten carbonate fuel cell.** Singh, R.N.; Dusek, J.T. US Patent Application 107,741. 27 Dec 1979. 25p.

A porous tile for retaining molten electrolyte within a fuel cell is prepared by sintering particles of lithium aluminate into a stable structure. The tile is assembled between two porous metal plates which serve as electrodes with fuels gases such as H_2 and CO opposite to oxidant gases such as O_2 and CO_2. The tile is prepared with a porosity of 55 to 65% and a pore size distribution selected to permit release of sufficient molten electrolyte to wet but not to flood the adjacent electrodes.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

35063 (DOE/EIA—0184/18) **Marginal costs of energy in 1979: estimates by economic sector and fuel type. Analysis report.** Moden, B.; Hatcher, D.; Walton, H. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 40p. NTIS, PC A03/MF A01.

National level estimates of marginal energy costs in 1979 for each economic sector and major fuel type are presented. These costs include various energy taxes and subsidies, such as excise taxes and depletion allowances, but exclude energy price regulations, such as price controls on domestic crude oil. Adherence to a strict definition of marginal costs, e.g., the exclusion of fixed costs, was not possible for all fuel types due to the lack of data. Specific instances of this problem are discussed in detail. Most of the analysis is devoted to 1985 and beyond. There was some work on short-term (i.e., 1979 and 1980) energy-price forecasts, but this examined solely market, as opposed to marginal, energy prices. For this reason, the estimates provided in this report should be improved as new estimating procedures are developed. The Appendix develops factors to apportion national, marginal energy costs to the DOE Regions. These factors, however, should be used with the understanding that they are based on historical market-price data, not current information on regional, marginal energy costs.

BUILDINGS

REFER ALSO TO CITATION(S) 35017, 35046, 35054, 35055, 35056, 35098

35064 (AD-A—078619/4) **Intelligent lighting control principles. Report for oct 78-apr 79.** Pierpoint, W. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Jul 1979. 24p. NTIS, PC AA02/MF A01.

It is generally recognized that compared to illumination from ceiling-mounted electric lighting, an equal amount of daylight illumination from windows can be about three times more effective in producing visibility. If this is true, then visibility-based lighting controls will result in greater energy conservation than will illumination-based lighting controls. A mathematical technique has been developed suitable for an intelligent microprocessor-based equi-visibility lighting control system. In an example room, a computer simulation compares the energy consumption for on-off, high-low-off, equi-illumination, and equi-visibility lighting controls systems.

35065 (ANL/CNSV-TM—39) **Development regulation changes local elected leaders can make to promote energy conservation.** Kron, N.F. Jr. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 24p. NTIS, PC A02/MF A01.

This report lists actions that local officials can make to change their community's development regulations and thereby lessen the effects of local energy problems. The term development regulations, as used here, is a general reference to local or state controls over land use and development that affect design, orientation, placement, location, and related characteristics of buildings and infrastructure. The regulations include items such as zoning, subdivision controls, setbacks, yard and height requirements, and solar-access ordinances.

35066 (BTHE—010104) **Survey of electrical safety requirements for air conditioning units in France.** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). 1978. 31p. Price to members $110.00.

The survey outlines the general situation relating to electrical equipment and the particular situation relating to air conditioning units in France. The information has been selected from THE's data bank and is believed to be correct at the date shown on the title page. The report is presented in sections as follows: a brief outline of the equipment approval and installation practice; a section entitled Organizations and their Functions, itemizing the various authorities either responsible for the issuing of technical requirements or for the enforcing of them; a summary, entitled Regulations and Technical Requirements, of the relevant official general national requirements relating to equipment and installations existing; and a schedule giving, in tabular form, the standards, national and international, which are applied in the country for the equipment under review and also to major components thereof. The schedule shows whether approval in each country is compulsory by law or voluntary.

35067 (BTHE—010105) **Survey of electrical safety requirements for air conditioning units in the Federal Republic of Germany.** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). 1978. 39p. Price to members $110.00.

The survey outlines the general situation relating to electrical equipment and the particular situation relating to air conditioning units in West Germany. The information has been selected from THE's data bank and is believed to be correct at the date shown on the title page. The report is presented in sections as follows: a brief outline of the equipment approval and installation practice; a section entitled Organizations and their Functions, itemizing the various authorities either responsible for the issuing of technical requirements or for the enforcing of them; a summary, entitled Regulations and Technical Requirements, of the relevant official general national requirements relating to equipment and installations existing; and a schedule giving, in tabular form, the standards, national and international, which are applied in the country for the equipment under review and also to major components thereof. The schedule shows whether approval in each country is compulsory by law or voluntary.

35068 (BTHE—010106) **Survey of electrical safety requirements for air conditioning units in Italy.** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). 1978. 25p. Price to members $110.00.

The survey outlines the general situation relating to electrical equipment and the particular situation relating to air conditioning units in Italy. The information has been selected from THE's data bank and is believed to be correct at the date shown on the title page. The report is presented in sections as follows: a brief outline of the equipment approval and installation practice; a section entitled Organizations and their Functions, itemizing the various authorities either responsible for the issuing of technical requirements or for the enforcing of them; a summary, entitled Regulations and Technical Requirements, of the relevant official general national requirements relating to equipment and installations existing; and a schedule giving, in tabular form, the standards, national and international, which are applied in the country for the equipment under review and also to major components thereof. The schedule shows whether approval in each country is compulsory by law or voluntary.

35069 (BTHE—010107) **Survey of electrical safety requirements for air conditioning units in Spain.** (British Standards Institution, Hemel Hempstead (UK). Technical Help to Exporters). 1978. 19p. Price to members $110.00.

The survey outlines the general situation relating to electrical equipment and the particular situation relating to air conditioning units in Spain. The information has been selected from THE's data bank and is believed to be correct at the date shown on the title page. The report is presented in sections as follows: a brief outline of the equipment approval and installation practice; a section entitled Organizations and their Functions, itemizing the various authorities either responsible for the issuing of technical requirements or for the enforcing of them; a summary, entitled Regulations and Technical Requirements, of the relevant official general national requirements relating to equipment and installations existing; and a schedule giving, in tabular form, the standards, national and international, which are applied in the country for the equipment under review and also to major components thereof. The schedule shows whether approval in each country is compulsory by law or voluntary.

35070 (LBL—11300(Draft)) **Energy efficient buildings. Technical potentials and policy recommendations for conservation and renewable resources: a least cost scenario, 1980-2000.** Rosenfeld; Goldstein; Harris; Claridge; Gawell. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 25 Jul 1980. Contract W-7405-ENG-48. 407p. NTIS, PC A18/MF A01.

Working from the premise that the largest and least expensive source of energy in the US in the next 20 y is the energy that could be saved in buildings, building energy consumption in commercial and residential buildings is examined, and the energy savings which could be accomplished by more efficient building design, by energy conserving retrofits and by the use of solar heating equipment are discussed. (LCL)

35071 (PB—80-122179) **Wood stoves for low income families in Virginia: lessons learned from the energy assistance program.** Reynolds, L.J.; Brumfield, C.P.; Kinney, L.F. (Syracuse Research Corp., NY (USA). Energy Research Center). Aug 1979. 75p. NTIS, PC A04/MF A01.

The Virginia Association of Community Action Agencies (VACAA) energy staff conducted a search for alternatives to only making payments to fuel vendors on behalf of low-income clients.

The decision was to launch a state-wide wood stove program using funds earmarked for emergency energy services. It was found that a good quality wood stove could be installed for well under the $250 limit. This report is based on knowledge the investigators had of the program during its operational phases and on interviews conducted with clients, administrators, and other people involved in the program from throughout the State.

35072 (PB—80-124944) **Maintenance of spray humidifiers.** Brundrett, G.W. (Electricity Council Research Centre, Capenhurst (UK)). Feb 1979. 16p. NTIS, PC A02/MF A01.

Recycled water can become a breeding medium for micro-organisms particularly if there is nutrient such as organic dust present. If such micro-organisms and/or their metabolites are injected into the atmosphere in quantity by a spray humidifier then the room occupants are liable to develop flu-like symptoms now known as 'humidifier fever'. The symptoms are worst on re-exposure after an interval and lead to the expression 'Monday sickness'. Any industrial process involving both humidification and organic dust offers a potential breeding ground for the micro-organisms. The most common process combining the two is the stationery and printing industry. Winter humidification is necessary and nutrients in the form of airborne cellulose from the paper are plentiful. Particularly high standards of maintentance, including regular cleaning and prevention of sludge buildup is needed.

RESIDENTIAL BUILDINGS

35073 (BNL—28192) **Approach to performance evaluation of a double wall convective loop house.** Ghaffari, H.T.; Jones, R.F.; Dennehy, G. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 7p. (CONF-801016—14). NTIS, PC A02/MF A01.

From 5. national passive solar conference; Amherst, MA, USA (19 Oct 1980).

A double wall house of Ekose'a design, located in Middletown, RI, is being evaluated by Brookhaven National Laboratory under sponsorship of the US Department of Energy. The technical approach employed in monitoring and analyzing the thermal performance of the building is described.

35074 (CONF-800460—6) **Physical properties of residential insulations.** Yarbrough, D.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01.

From 82. annual American Ceramic Society meeting; Chicago, IL, USA (27 Apr 1980).

Research to evaluate properties, test methods and operating environments for thermal insulations used in residences is an important part of the Building Thermal Envelope Systems and Insulating Materials (BTESIM) program sponsored by the US DOE. Three projects were carried out under the Insulating Materials part of BTESIM. The areas discussed are: (1) the thermal performance of mineral fiber insulating batts, (2) the design density for loose-fill insulations, and (3) the operatio of recesses light fixtures covered by loose-fill cellulosic insulation.

35075 (DOE/EI/10509—T1) **Household energy demand: a theoretic and econometric specification.** Brown, R.S.; Kwast, M.L. (Social and Scientific Systems, Inc., Washington, DC (USA); Mathematica Policy Research, Inc., Washington, DC (USA)). Jun 1980. Contract AC01-79EI10509. 89p. NTIS, PC A05/MF A01.

One of the major concerns in assessing the impact of energy-conservation policy is the manner in which its impact is distributed across various segments of the population. Accurate assessment of these effects for any actual or proposed policy requires the existence and use of a model which estimates and simulates the response of households to energy policy changes. The Comprehensive Human Resources Data System (CHRDS) simulates these issues. The approach starts with a large sample survey of households and projects the sample to a future year with an updating of demographic, economic, and energy-using characteristics. Energy expenditures change over time as a function of prices directly, consumption changes induced by price changes, conversions of heating and water-heating fuel type, appliance ownership, appliance efficiency, the age and distribution of housing stock, insulation efficiency, auto ownership patterns, and the economic and demographic characteristics of the population. This paper develops the required theoretical model of household energy demand and presents an appropriate econometric specification. Section II presents the basic model of household energy demand proposed for estimation with the National Interim Energy Consumption Survey (administered to 3000 households in 1978-1979). Section III proposes explicit forms for the demand equations and presents the econometric specifications. Section IV discusses the incorporation of the proposed model into the existing CHRDS model. Section V outlines how the model could be extended to deal with the long run, while Section VI reviews the advantages of the proposed model over most other formulations, and then discusses ways in which the proposed model could be generalized and extended.

35076 (LBL—9653(Rev.)) **Mobile Window Thermal Test Facility (MoWiTT).** Klems, J.H.; Selkowitz, S.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 16 Oct 1979. Contract W-7405-ENG-48. 15p. (EEB-W—79-17(Rev.); CONF-791233—9(Rev.)). NTIS, PC A02/MF A01.

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

A Mobile Window Thermal Test Facility (MoWiTT) is currently being developed and is described. It consists of 4 test rooms (about 2.7 m x 2.1 m x 2.1 m high) with a guard room at each end. Each test room is designed to function as a calibrated hotbox. The interior air temperture may be accurately controlled by heating or cooling the chamber, and the amount of heat added or removed is carefully monitored. Heat loss or gain through the chamber walls is also measured, and the net gain or loss through the window can then be inferred. The instrumentation system is described. Construction of the facility is planned for late 1980.

35077 (LBL—10739) **Energy Conservation Inspection Service. Final report.** Meier, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01.

The results of a residential audit service in Berkeley, California are described. The evaluation consisted of telephone interviews of residents of audited homes and comparison of their utility records to both their previous consumption and to a control group. Neither analysis revealed statistically significant energy savings. Difficulties in the collection and analysis of the data are discussed.

35078 (NP—25074) **Discussion of proposed energy conservation standards for one- and two-family and manufactured dwellings (Wis. Adm. Code Ind 22). Research Bulletin 78-1.** (Wisconsin Legislative Council Staff, Madison (USA)). 15 Mar 1978. 54p. TIC.

Proposed energy conservation standards for all newly-constructed conventional and manufactured one- and two-family dwellings and additions to existing buildings used as one- and two-family dwellings are discussed. A description of the proposed code, background information on the insulation standards, alternative insulation standards and ways to meet them, implications of alternative insulation standards, and other related issues are presented.

35079 (PB—80-101355) **Investigation of air-infiltration characteristics and mechanisms for a townhouse. Final report.** Treado, S.J.; Burch, D.M.; Hunt, C.M. (National Bureau of Standards, Washington, DC (USA)). Aug 1979. 38p. NTIS, PC A03/MF A01.

Air infiltration measurements using a tracer-gas technique and the pressurization technique were performed on a three-bedroom townhouse having a gas-fired, forced-air furnace system, in order to quantify the amount of air infiltration due to various mechanisms. These mechanisms include combustion and draft-diverter air requirements, air leakage from supply-air ducts, and air leakage through the solid parts of the building envelope as well as air leakage through cracks around windows and doors. A thermographic survey was also performed in conjunction with pressurization of the structure, in an attempt to identify specific leaks. An apparatus for measuring the air permeability of building materials was used to analyze the significance of air permeation through solid building elements. Based on the findings of the study, general guidelines are presented for reducing air infiltration in residences.

OFFICE BUILDINGS

35080 (DOE/CS/20189—1) **Energy use in office buildings. Volume 1. Analysis of 1977 office building energy use as reported in the Building Owners and Managers Association Data Base.** (General Electric Co., Washington, DC (USA)). 29 Aug 1980. 136p. NTIS, PC A07/MF A01.

This report presents the results of Task IA of the Energy Use in Office Buildings Project: an analysis in tabular form of the 1977 office building energy use data base of the Building Owners and Managers Association (BOMA). BOMA's approximately 4000 members directly manage over 500 million ft^2 of commercial office space, which is approximately 16% of total commercial office building space. BOMA annually collects data on office building characteristics and operating performance for presentation in its Experience Exchange Report. Data are collected from BOMA member and non-member buildings electing to participate in the reporting process; and, in addition, a number of Federal, state, and local government buildings have been participating since 1977. Summaries of the data are published by BOMA on an aggregate basis; the summaries, which are developed on a city or regional basis, provide a benchmark for use by building managers in comparing the results of specific building operations with the industry's aggregate experience. Access to the 1977 BOMA data base was obtained under a subcontract with BOMA. Data for 1342 buildings - 1059 commercial office buildings and 283 government office buildings in the United States and Canada - were delivered. Of the 1059 commercial office buildings, 999 were located in the US. A total of 233 Federal-, state-, and local-government-operated buildings located in the US were also in

the data base. Energy use data were reported by BOMA in terms of kWh of electricity, ft^3 of gas, gal of oil, and lb of steam. The data were converted to BTU's, and all building energy measures were expressed in terms of Btu/ft^2. Section II presents analysis for commercial office buildings; and Section III presents the analysis for government office buildings.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

35081 Energy Conservation Assistance Act of 1979. Sacramento, CA; California Energy Commission (1979). 38p. (NP—24994).

The Energy Conservation Assistance Act (ECAA) of 1979 authorizes the California Energy Commission (CEC) to loan state funds to schools, hospitals, public-care institutions, and units of local government for financing energy-conservation-related projects. Any eligible institution may submit an application to the CEC for a loan to finance all or a portion of the costs to implement an energy-conservation project. There are three steps in the ECAA state loan program: (1) conduct an energy audit (EA) which identifies low-cost and no-cost building and equipment operation and maintenance modifications; (2) conduct a technical-assistance audit (TA) which is a specialized study to identify more-costly energy-savings measures; and (3) complete an Energy Conservation Measure (ECM) which implements facility modifications identified during the TA. Included here are samples of the following: Program Instructional Guide; State Loan Application; Loan Agreement; Promisory Note; and Fair Employment Practices Addendum.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 35080

35082 Engineer's manual of energy conservation literature for industrial applications. No. 78-001. Austin, TX; Energy Engineering Associates, Inc. (1978). 240p. (NP—25086). Texas Industrial Commission, Austin, TX.

A manual to aid engineers responsible for conducting comprehensive energy audits of industrial processes and as an aid for carrying out energy conservation programs in industrial plants is presented. Over 400 references of direct relevence to industrial energy conservation are classified in subject areas which parallel the needs of the engineer. Section 1, Industry-Specific Literature, contains articles and reports which address energy-conservation problems in particular types of industrial plants. There are 7 subsections: chemicals and chemical products, foods and food products, metals and metal products, mineral products, paper and paper products, petroleum refining, and general energy audits. Section 2, Equipment and Process-Specific Literature, contains material of particular value when assessing energy-conservation potential for particular components or processes.

TRANSPORTATION

REFER ALSO TO CITATION(S) 35050

AIR AND AEROSPACE

35083 (DOE/CS/50069—1) **Aircraft towing feasibility study. Final report.** (Peat, Marwick, Mitchell and Co., San Francisco, CA (USA)). Sep 1980. Contract AC01-79CS50069. 174p. NTIS, PC A08/MF A01.

Energy costs and availability are major concerns in most parts of the world. Many ways of increasing energy supply and reducing consumption are being proposed and investigated. One that holds considerable promise is the extended towing of aircraft between airport runways and terminal gate areas with engines shut down. This study provides a preliminary assessment of the constraints on and feasibility of extended aircraft towing. Past aircraft towing experience and the state-of-the-art in towing equipment are reviewed. Safety and operational concerns associated with aircraft towing are identified, and the benefits and costs of implementing aircraft towing at 20 major US airports are analyzed. It was concluded that extended aircraft towing is technically feasible and that substantial reductions in aircraft fuel consumption and air pollutant emissions can be achieved through its implementation. It was also concluded that, although capital and operating costs associated with towing would be increased, net savings could generally be attained at these airports. Because of the lack of past experience and the necessity of proving the cost effectiveness of the towing concept, a demonstration of the feasibility of large-scale aircraft towing is necessary. The study evaluates the suitability of the 20 study airports as potential demonstration sites and makes recommendations for the first demonstration project.

RAILWAY

35084 (PB—80-118326) **Resistance of a freight train to forward motion. Volume II: implementation and assessment. Interim report.** Muhlenberg, J.D. (Mitre Corp., McLean, VA (USA). METREK Div.). Apr 1979. Contract DOT-FR-54090. 162p. NTIS, PC A08/MF A01.

The report is a supplement to a previous report and documents the results of the second portion of an investigation of the train resistance phenomenon. This portion of the effort was specifically directed toward determination of possible fuel savings to be effected through certain design improvements or equipment modifications when a freight train is operated over normal track, including grades and curves. The results of 52 simulated runs of various freight trains over various tracks, both real and artificial, are reported. The simulations show that fuel savings are not directly proportional to reductions in train resistance and that under certain circumstances only a portion of the theoretically attainable fuel savings can be achieved. It is also shown that fuel savings can be achieved. It is also shown that fuel savings attributable to certain of these modifications are quite dependent upon the nature of the operation in which they are used. Within limits, the computer program developed during this study can be used to determine the fuel consumption of an arbitrary train operated over an arbitrary track to perform sensitivity analyses with respect to locomotive assignment policy, operational speed limit, and the like, and to determine the effect of design improvements or equipment modifications upon fuel consumption under normal operating conditions. The computer program which performs the calculation is explained in detail and the rationale behind its development is given.

35085 (PB—80-121478) **Flywheel energy storage switcher. Volume 1. Study summary and detailed description of analysis. Final report, September 1977-January 1979.** Cook, L.M.; Curran, W.T.; McConnell, R.; Smith, A.K. (AiResearch Mfg. Co., Torrance, CA (USA)). Apr 1979. Contract DOT-FR-777-4247-1. 346p. NTIS, PC A15/MF A01.

An indepth study of the application of flywheel energy storage to the railroad switchyard locomotive was conducted to determine the practicality and viability of such a system. The system, as originally conceived, required the use of separately excited traction motors, and a major task of the study was to test separately excited version of the Electro-Motive Division's D77 traction motor. The attractiveness of the system is very dependent on the operational scenario of the switching locomotive. Therefore, the study examined the operation of locomotives at three flatyards: Dillard (Southern Railway System), Baldwin (Seaboard Coast Line), and Whitefish (Burlington Northern). Also, a large amount of data concerning the operating environment of switching locomotives was collected. It was concluded early in the study that a boxcar was required to carry the energy storage unit because no room existed on the locomotive. This, combined with the increased auxiliary load, results in the same energy consumption with or without the FESS system, for a typical flatyard operation in spite of the energy recuperated and reused. Brake maintenance savings, although significant, are not sufficient to give an attractive return on investment.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 35125, 35137, 35138

35086 (PB—80-114002) **Impacts of urban mass transportation administration capital grants programs. Working paper.** Merewitz, L. (National Transportation Policy Study Commission, Washington, DC (USA)). Jan 1979. 61p. NTIS, PC A04/MF A01.

The paper attempts to analyze the impacts of UMTA capital grants in terms of eleven national transportation goals: adequate service; appropriate rates and prices; economic efficiency; energy conservation; environmental protection; safety; employment generation; industry promotion and protection; regional and urban development; equity; and national defense. Where they are quantifiable, benefits and costs of grant programs are estimated for each goal. In general, grants for buses are found to be more cost effective than grants for urban rail.

35087 (PB—80-122419) **Tire programs - several approaches with significant potential to decrease fuel consumption. Technical report.** Thompson, G. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jun 1979. 11p. NTIS, PC A02/MF A01.

Several approaches have been identified which have the potential to significantly reduce annual fuel consumption. The approaches are an information program to allow consumer selection of fuel-efficient tires and incorporation of tire inflation pressure maintenance in existing or planned inspection programs. A tire information program has the potential to reduce fuel consumption by 3 billion gallons annually. An annual inflation inspection and maintenance program could be expected to save approximately 300 million gallons. A consumer information program on the fuel economy aspects

of tire inflation pressures could also be cost effective. The report discusses these several approaches to save several billion gallons of gasoline annually.

SEA AND WATER

REFER ALSO TO CITATION(S) 35094, 35112

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 35017, 35046, 35054, 35055, 35056

ENERGY SOURCES

35088 **Industrial energy consumption studies. Part I. The aluminum industry.** Hassoun, H. Salem, OR; Oregon Department of Energy (1978). 110p. (NP—25090).

The energy consumption characteristics of Oregon's major industries, specifically the aluminum industry, are presented. The two plants in Oregon employ 1445 persons. In 1976, the total direct economic impact of the two plants was more than $62 million. The plants accounted for 11.3% of total state electricity consumption and 28.7% of electricity consumption in the state's manufacturing sector in 1976. Energy consumption in the Pacific Northwest is also examined.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 35082

35089 (ANL/CNSV—8) **Energy and materials flows in the fabrication of iron and steel semifinished products.** Darby, J.B. Jr.; Arons, R.M. (Argonne National Lab., IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 73p. NTIS, PC A04/MF A01.

Includes appendix.

The flow of energy and materials in the fabrication of iron and steel semifinished products from molten metal is discussed. The focus is on techniques to reduce the amount of energy required to produce the typical products of integrated steel plants and iron and steel foundries. In integrated steel plants, if only 50% of the steel being cast were continuously cast, industry-wide energy consumption would be reduced by 6 to 15%. Further major energy savings could be achieved by increased use of by-product gases and regenerators in the various reheat operations. Finally, systems optimization studies to maintain the even flow of materials at full capacity should yield further improvements in energy efficiency. In foundry operations, alternate heating methods in forging operations and the use of no-bake molding and core materials should result in substantial energy savings. Studies of specific operations will suggest housekeeping changes to minimize wasted energy. These changes might include fixing heat leaks, reducing floor space requirements, improving temperature regulation, lowering working temperatures in some steel-forming operations, redesigning products, and minimizing scrap generation. There is also a need for new, energy conserving technologies. A good example would be the development of nondestructive testing to determine the existence, location, and size of defects in ingots at elevated temperatures. A second example is the need to reduce, through system studies, the large amount of scrap typical of foundry operations. Finally, computer control of steel mill operations (materials flow, furnace residence times, excessive heating or overheating, and full capacity utilization of all facilities at all times) deserves further study.

35090 (ANL/CNSV-TM—41) **Summary of current state industrial energy conservation programs.** Anderson, R.W.; Evans, A.R.; Grogan, P.J. (Argonne National Lab., IL (USA)). May 1980. Contract W-31-109-ENG-38. 35p. NTIS, PC A03/MF A01.

A preliminary study of industrial energy conservation measures initiated by states under the State Energy Conservation Program is presented. Elements, targets, and administration of state programs are briefly examined. As the results of the study indicate, the states perceive the need for Federal assistance in programs to: establish a forum for coordination of state programs and interchange of approaches and program materials; provide to state offices direct technical assistance, including specific program information, training materials and manuals directed toward specific industries, and an energy accounting methodology; promote national industrial energy conservation measures; develop methods for providing financial assistance to companies, especially small business, for incorporating energy conserving measures; devise a plan for coordinating the state energy-related regulatory activities; and disseminate information on Federal programs and regulations that may impact energy-related decisions at the state level and within private industry.

35091 (DOE/CS/40263—T1) **Energy conservation in citrus processing. Technical progress report, October 1, 1979-March 31, 1980.** (Jet Propulsion Lab., Pasadena, CA (USA); Sunkist Growers, Inc., Ontario, CA (USA)). 15 Jun 1980. Contract AC03-79CS40263. 89p. NTIS, PC A05/MF A01.

The Sunkist Citrus Plant in Ontario, California, processes about 6 million pounds of citrus fruit per day to make products which include frozen concentrated juice; chilled, pasteurized, natural strength juice; molasses from peel; dried meal from peel; pectin; citrus oil; and bioflavonoids. The energy intensive operations at the plant include concentration, drying, and refrigeration. The objective of the two-year two-phase project is to identify an economically viable alternative to the existing method of meeting energy requirements. Progress on the technical work of Phase I is reported. The following are summarized: requirements (energy price projection, atmospheric emission requirements, citrus juice quality constraints, economic evaluations); characterization (basic citrus processing operations, energy consumption and fruit processed vs time, identification and measurement of energy uses, energy balance for a typical citrus juice evaporator); and thermodynamic analysis (heat pump model, thermal evaporator, and co-generation model).

35092 (PB—80-110992) **Study of the in-situ indirect freezing process. Volume I. Final report.** Cheng, C.Y. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Jul 1979. Contract DI-14-34-0001-7502. 98p. NTIS, PC A05/MF A01.

It has been demonstrated that high degree separations of aqueous and organic mixtures can be accomplished and an energy saving can be realized by the In-situ Indirect freezing process conducted in a small conduit freezer-melter. The process has two versions: the first version, denoted as the dendritic deposit approach, is useful in accomplishing a high degree separation of a concentrated solution and the second version, denoted as the smooth deposit approach, is useful in a high degree purification of a dilute solution. A pressure-induced nucleation approach and a seeded feed approach with ultrasonic nucleation have been introduced to initiate a freezing step uniformly; a pressure-programmed supersaturation approach has been introduced to obtain a close control of delta t and a close control of the morphology of the deposited solid phase. Products containing less than 350 ppM NaCl were obtained from feeds containing 40,000 ppM and 5000 ppM, respectively, by the two approaches.

35093 **Use of litter for broiler house heating.** Smith, N.; Riley, J.G.; Kittridge, C.W.; Putnam, N.E. St. Joseph, MI; American Society of Agricultural Engineers (1978). 15p. (CONF-781238—3).

From Winter meeting for American Society of Agricultural Engineers; Chicago, IL, USA (18 Dec 1978).

Development of prototype fireboxes intended to burn broiler litter is described. Details of a unit designed to burn pelleted litter and replace the oil burner on an existing boiler are provided.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 34734, 35089

35094 (AD-A—078154) **Waste heat recovery unit design for gas turbine propulsion systems. Master's thesis.** Combs, R.M. (Naval Postgraduate School, Monterey, CA (USA)). Sep 1979. 300p. NTIS, PC A13/MF A01.

A design model for a once-through waste heat recovery unit with a segmented fin-tube arrangement was developed along with a simple model of a combined gas and steam (COGAS) turbine propulsion system. These models were integrated and applied in a computer program written in FORTRAN IV for the IBM 360-67 computer. Waste heat recovery unit designs were produced and tested at off-design conditions. Using the space constraints and power requirements of a Navy destroyer-type ship, one design was selected and employed to make estimates of possible fuel savings to be realized through the application of a COGAS system.

35095 (DOE/CS/40257—1) **High temperature recuperator tests. Final report.** Bjerklie, J.W.; Penty, R.A. (Hague International, South Portland, ME (USA)). May 1980. Contract AC02-79CS40257. 45p. NTIS, PC A03/MF A01.

A demonstration and test program was conducted on a high temperature, two pass ceramic tube recuperator. Data pertaining to heat exchanger performance characteristics were collected and compared with calculated values. The effect of improved heat exchanger effectiveness on system fuel consumption was demonstrated. Changes in fuel flow as a function of combustion air preheat while maintaining a given heat load were demonstrated. The effects of excess air on fuel consumption with and without system recuperation were demonstrated. A preheat level of 1740°F with a heat exchanger inlet of 2537°F for a recuperator effectiveness of 68% was demonstrated. Comparison of test measurements and calculated heat balance and heat transfer characteristics indicated that the measured effects of recuperation and excess air levels on fuel consumption were close to theoretical values. A post-program examination of the recuperator indicted that no damage to the recuperator occurred

that could not be alleviated by minor design modification. The modifications necessary to achieve 1800 to 2000°F preheat with a ceramic tube recuperator of the type demonstrated were extrapolated from measurements made in this program. The same two pass approach demonstrated in this program can be used. The number of face tubes vs. pressure drop for increased recuperator effectiveness was calculated. Modifications and procedures necessary to achieve a 1800 to 2000°F preheat with furnace temperatures between 2500°F and 2800°F are discussed.

35096 (PB—80-113392) **Power plant waste heat utilization in aquaculture. Annual report No. 2, 1 November 1977-1 November 1978.** Guerra, C.R.; Godfriaux, B.L.; Eble, A.F.; Farmanfarmaian, A.; Pitman, R. (Public Service Electric and Gas Co., Newark, NJ (USA). Research and Development Dept.). Nov 1978. 295p. NTIS, PC A13/MF A01.

Progress at the Mercer (NJ) Proof-of-Concept Aquaculture Facility is reported. The objective is to evaluate the potential of using power plant thermal discharges in condenser cooling water to enhance the productivity of rainbow trout and channel catfish in an aquaculture system. Indirect benefits are reduction of thermal pollution and the partial recovery of low-grade waste energy from industrial effluents.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 35089, 35103

35097 (PB—80-124654) **Development of government procurement guidelines for construction products containing recovered materials. Final report, May 1978-August 1979.** Reif, H.G.; Ziegler, R.C. (Calspan Corp., Buffalo, NY (USA)). Oct 1979. Contract EPA-68-01-4789. 152p. NTIS, PC A08/MF A01.

The objective of the study was to acquire, interpret, and develop information on construction products containing recovered materials and to formulate possible guidelines for promulgation. Seven material categories were considered: iron and steel; aluminum; fly ash; paper; rubber; glass; and plastic. Manufacturing processes for selected construction products were reviewed and the potential for increased utilization of recovered materials were assessed.

MUNICIPALITIES AND COMMUNITY SYSTEMS

35098 (DOE/CS/20056—1) **Energy-conserving site design: case study, The Woodlands, Texas.** Swanson, M. (The Woodlands Development Corp., TX (USA)). Mar 1980. Contract AC01-78CS20056. 164p. NTIS, PC A08/MF A01.

The Woodlands is a HUD Title VII New Town located north of Houston. It includes 22,000 acres and the plan for the new town consists of 6 residential villages, a town center called the Metro Center and several additional tracts, such as the Trade Center for larger-scale industrial use. Each village is to be structured around one large and several supporting neighborhood centers. Ultimate population is planned to be 150,000. Included in this report are sections on background, team structure and organization, methodological considerations, the conventional and energy-conserving plan, constraints to implementation, and general conclusions and next phases.

PUBLIC UTILITIES

35099 (COO—4212-1/2) **Trenton ices. Volume 2, Phase 1. Final report.** (Trenton City Dept. of Planning and Development, NJ (USA)). 14 Jul 1977. Contract AC02-77CS20055. 416p. NTIS, PC A18/MF A01.

Phase I Preliminary Design and Evaluation for Grid-Connected Thermally Controlled Integrated Community Energy System (ICES) for the City of Trenton, New Jersey has been carried out. The findings of the study are: (1) it is technically feasible, utilizing commercially available hardware; (2) it is economically competitive with conventional alternatives for heating and cooling buildings; (3) it will produce an overall reduction in fuel consumed of from 32 to 43% when compared with conventional alternatives for heating and cooling buildings; (4) it will consume 4 to 9% more oil than will conventional alternatives for heating and cooling buildings; (5) it should be owned and operated by PSE and G, and no major institutional impediments have been discovered under this arrangement; and (6) it can provide thermal energy 21 months after the start of Phase II and electrical energy 32 months after the start of Phase II. This study is site-specific and of a small size project. Its installation will not alter the planned PSE and G capacity expansion program. The economic evaluation results cannot be extrapolated for numerous co-generation installations that would affect the PSE and G planned capacity expansion program. On the basis of the above findings, the members of the Phase I Demonstration Team for Trenton ICES analysis are positively disposed toward proceeding with the Phase II design of the plant in order to conclusively test system viability with the ultimate goal of plant construction.

35100 (PB—80-121924) **Modular Integrated Utility System (MIUS) demonstration project, St. Charles, Maryland. Preliminary design. Volume 1. Sections 1 to 10. Book 1 of 2.** (Interstate Land Development Co., Inc., St. Charles, MD (USA)). Sep 1978. 174p. NTIS, PC A08/MF A01.

Addressed to planners, utility experts, and local officials, this technical report documents the design and economic evaluation of a proposed Modular Integrated Utility System (MIUS) project in St. Charles, Maryland. The MIUS concept, developed by HUD as a response to the energy problem, brings together subsystems that serve community utility needs and builds them into a master system that offers advantages over conventional utilities. The MIUS provides electricity, heating, cooling, wastewater treatment, and solid waste processing; it reclaims thermal energy produced as a byproduct of electrical power generation and incineration of solid waste and wastewater sludge. The selected demonstration site in St. Charles, judged to be representative of typical high density community development in the US, consists of retail commercial buildings surrounded by apartments. The MIUS designed for St. Charles contains four subsystems dealing with electrical service, thermal service, solid waste management, and wastewater management. Although future costs of fuel, labor, utilities, etc., can only be estimated, this report contains sets of assumptions which were used in economic evaluations of MIUS plant economics. Among the key assumptions are that all operating costs and revenues will escalate at 8% a year and MIUS thermal services will be priced at 10% less than comparable conventional heating and cooling services obtainable by use of air source heat pumps. Using a discounted cash flow technique for escalating the initial MIUS site, and assuming no expansion, researchers calculated an internal rate of return (IRR) of 1.2%. The comparable ultimate - site - expanded analysis shows an IRR of 8%. Advantages and deterrents to instituting MIUS concepts are discussed; opportunities for testing are noted. Extensive statistical data and charts are included.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 35283

35101 (CONF-7911107—1) **SWARU: blueprint for the future.** Palombella, R.F.; Kennedy, J.W. (Regional Municipality of Hamilton-Wentworth, Hamilton, Ontario (Canada). Dept. of Engineering; Tricil Ltd., Mississauga, Ontario (Canada)). 1979. 29p. NTIS (US Sales Only), PC A03/MF A01.

From Energy from waste conference: a decade of development; Toronto, Ontario, Canada (21 Nov 1979).

The design, operation, performance and economics of the Solid Waste Reduction Unit, SWARU, which began operation at Hamilton, Ontario in 1972, are discussed. This facility handles more than 100,000 tons per yr. of municipal waste. At the SWARU waste is coarsely pulverized to a nominal size of 4 to 6 in., the ferrous metals are magnetically recovered, the remaining pulverized refuse is fed into spreader stoker boilers through air-swept feeders, the waste is fired as it drops toward the grate, and burning is completed on the grate to produce steam. About 25% of this steam is used by in-plant turbines. The remainder is for sale. This plant using known equipment to achieve simple waste processing and high combustion efficiency has proven the reliability and cost effectiveness of energy recovery from municipal wastes. (LCL)

35102 (PB—80-102874) **Assessment of the impact of resource recovery on the environment. Final report.** Gordon, J.G. (Mitre Corp., McLean, VA (USA). METREK Div.). Aug 1979. Contract EPA-68-03-2596. 147p. NTIS, PC A07/MF A01.

This assessment of the environmental impact of resource recovery examines the environmental effects that will derive from municipal solid waste disposal in 1990 and the changes in these effects that will result from implementation of resource recovery from municipal solid waste. The environmental effects considered in this study are the direct effects of municipal solid waste disposal as well as the secondary effects of substituting materials recovered from municipal solid waste for raw materials in the production of steel, aluminum, glass, and energy. The energy aspects of resource recovery - that is, energy conservation resulting from use of recovered scrap in materials production and energy production by recovery of energy from municipal solid waste - are also evaluated. The analysis is based on specific scenarios for municipal solid waste disposal in 1990 without and with implementation of resource recovery.

35103 (PB—80-120645) **Small modular incinerator systems with heat recovery: a technical, environmental, and economic evaluation.** Frounfelker, R. (Systems Technology Corp., Xenia, OH (USA)). 1979. Contract EPA-68-01-3889. 275p. NTIS, PC A12/MF A01.

This report is a technical, economic and environmental evaluation of two small modular incinerator systems with heat recovery. One unit in North Little Rock, Arkansas has a thru-put of 100 tons of municipal solid waste per day and recovers steam. The other unit is a 25 TPD device located at the Rockwell Plant in Marysville, Ohio, and burns in plant waste to produce steam for heating and cooling the factory.

35104 **Energy and resource recovery from the Ames solid waste system.** Chantland, A.O. Ames, IA; City of Ames Public Works (May 1979). 10p. (NP—25101).

The City of Ames, Iowa has been involved with processing waste for over two years, selling valuable resources and using the processed solid waste as a fuel at its electric generating station. Ames has contracts with 12 communities, a county government, and a large state agency. Construction, operation, and the economics of the system are described.

EDUCATION AND PUBLIC RELATIONS

35105 (DOE/CS—2671-01) **Energy Extension Service Pilot Program: evaluation report after two years. Volume I. Evaluation summary.** (ICF, Inc., Washington, DC (USA); Westat, Inc., Rockville, MD (USA)). Apr 1980. Contract AC01-77IR02671. 250p. NTIS, PC A11/MF A01.

The EES pilot program was initiated in August 1977, when 10 states were selected on a competitive basis for participation. The pilot states (Alabama, Connecticut, Michigan, New Mexico, Pennsylvania, Tennessee, Texas, Washington, Wisconsin, and Wyoming) devoted the first 6 months to start-up activities. This document is a follow-up report to the three volume Evaluation Summary of the first year of the pilot EES program published in September 1979. The purpose of this report is to provide an overview of the impacts and costs of the two years of the pilot program, and to check the consistency of findings over the two year period. The analysis addresses the following: (1) were the impact findings of Year I and Year II consistent, or did Year I and Year II attitudes and behavior vary. If variation existed, could it be attributed to program changes as the EES progressed from a start-up phase (Year I) to more normal service delivery (Year II); and (2) did costs of service delivery change (again reflecting start-up and normal service delivery costs). Did cost changes affect conclusions about the relative cost effectiveness of delivering services to different target audiences.

35106 (DOE/CS—02671-02) **Energy Extension Service Pilot Program: evaluation report after two years. Volume II. State reports.** (ICF, Inc., Washington, DC (USA); Westat, Inc., Rockville, MD (USA)). Apr 1980. Contract AC01-77IR02671. 660p. NTIS, PC A99/MF A01.

This report, Vol. II, presents a discussion of the operations of the ten EES pilot state programs during the period from October 1, 1977 through September 30, 1979. Each of the ten pilot states - Alabama, Connecticut, Michigan, New Mexico, Pennsylvania, Tennessee, Texas, Washington, Wisconsin, and Wyoming - received a grant of approximately $1.1 million to develop and implement an 18-month program beginning on October 1, 1977. In September 1978, each State received an additional $370,000 for service-delivery programs for the extension of the pilot program, April 1979 through September 1979. A case-study description of the operations of the pilot program in each State is provided here, with special attention given to the two programs selected in each State for more-detailed study and survey research. Although the thrust of this volume is descriptive, some survey data and analyses are presented for the emphasis programs. Two telephone surveys of clients and a non-client sample were conducted, one at the end of the first year of the pilot program (October 1977 - September 1978) and one at the end of the second year (October 1978 - September 1979).

35107 (DOE/IR/00033—T2) **Energy-related doctoral scientists and engineers in the United States, 1977.** (Oak Ridge Associated Universities, Inc., TN (USA)). Apr 1980. Contract AC05-76OR00033. 98p. NTIS, PC A05/MF A01.

Information is compiled about the number and characteristics of doctoral-level engineers and scientists in primarily energy-related activities. These data are for the year 1977 and are part of the data base for a program of continuing studies on the employment and utilization of all scientists and engineers involved in energy-related activities. Data on mathematics, physics, chemistry, environmental engineering, engineering, life sciences, psychology, and social sciences doctoral degree specialties are included.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 35140, 35141

35108 (SSS-R—80-4620) **Numerical modeling of inlet manifold flows in internal combustion engines. Final report.** Chapman, M. (Systems, Science and Software, La Jolla, CA (USA)). Aug 1980. Contract AC04-80ET15498. 57p. NTIS, PC A04/MF A01.

A numerical procedure is developed to incorporate a two-equation turbulence model into the DELTA algorithm (Dynamic Euelerian Lagrangian Triangular Algorithm). The turbulence model will allow more realistic simulations of inlet and exhaust flow in internal combustion engines and provide data on the usefulness of a two-equation turbulence model in calculating flows in internal combustion engines.

DIESEL

35109 (AD-A—078665/7) **Diesel engine endurance test with water-containing fire-resistant fuel. Interim report Mar-Sep 77.** Moffitt, J.V.; Owens, E.C.; Wright, B.R.; Weatherford, W.D. Jr. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Sep 1979. Contracts DAAG53-76-C-0003;DAAK70-78-C-0001. 60p. NTIS, PC AA04/MF A01.

A production LDT-465-1C multifuel diesel engine was operated according to a double-length Army/CRC Wheeled Vehicle Test Cycle (420 total hours) using a fire-resistant diesel fuel containing 10 vol% water. The effects of this water-in-fuel macroemulsion on engine power output, deposits, wear, and oil degradation were examined. The results indicate that this fire-resistant fuel formulation, under the conditions evaluated, does not result in abnormal deposits nor are there any major effects (adverse or favorable) on engine wear or oil degradation. However, a significant loss in horsepower output as a function of test duration did result. Post-test examinations indicated the presence of fuel-origin deposits in the injection system which were attributed to the sugar-type surfactants used in this investigation.

35110 (AD-A—078798/6) **Combating high-sulfur fuel effects in a two-cycle, high-speed U.S. Army diesel engine. Interim report.** Frame, E.A. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Aug 1979. Contracts DAAK70-78-C-0001;DAAG53-76-C-0003. 177p. NTIS, PC AA09/MF A01.

Six lubricants were evaluated for their effectiveness in controlling the deleterious effects of using high sulfur diesel fuel. Two of the lubricants gave significant improvement in the condition of some engine areas; however, none of the engine oils tested would allow the continuous use of high sulfur fuel with no penalty in engine condition as compared to the use of low sulfur fuel.

35111 (PB—80-122443) **Characterization of gaseous and particulate emissions from light duty diesels operated on various fuels. Final report.** Hare, C.T. (Southwest Research Inst., San Antonio, TX (USA)). Jul 1979. Contract EPA-68-03-2440. 342p. NTIS, PC A15/MF A01.

Gaseous and particulate emissions of a non-routine nature were measured in the exhausts of two light-duty Diesel-powered automobiles. These vehicles were a Mercedes 240D and a Volkswagen Rabbit Diesel. Visible exhaust smoke, regulated gaseous pollutants, and exhaust odor were also measured. Five fuels were used in his investigation, representing broad ranges in sulfur content, hydrocarbon-type composition, density, centane index, and a number of other properties. Vehicle operating procedures used for test purposes included both those specified in Federal Regulations and several others simulating different driving situations. Gas samples were acquired from both direct and dilute exhaust streams. Particulate samples were taken using an exhaust dilution tunnel operating on the entire exhaust stream of each engine. Filter-collected particulate weights provided the basis for particulate mass emission calculations. The results of a statistical analysis of the particulate emissions data is included as in an analysis of gaseous emissions and particulate size data.

35112 (PB—80-126535) **Evaluation of techniques for improving combustion aboard ships. Part II. Medium speed diesel engines (intermediate grade fuels). Final report.** Horner, J.E.; Nunez, C.A. (Seaworthy Engine Systems, Inc., Essex, CT (USA)). Nov 1979. Contract MA-7-38058. 160p. NTIS, PC A08/MF A01.

This shipboard project evaluates three techniques for improving medium speed diesel combustion of intermediate marine fuel oils. It describes and appraises the values of fuel washing and fuel treatment by use of commercial additives with water-in-fuel oil

emulsions. The report discusses the rationale for fuel conditioning and the use of one approach to determine the optimum water/oil ratio for fuel oil emulsion application to improve combustion. Testing was performed aboard a twin-engined medium-speed diesel Catamaran Tug/Barge owned and operated by Seabulk Tankers, Ltd. Relative merits of the techniques as applied to engine operation and fuel consumption were determined. The comparative effects of fuel conditioning on critical hot gas path components is evaluated and the overall economics of the system when applied to a typical medium speed diesel propulsion plant are presented.

TURBINE

35113 (AD-A—078779/6) **Aerosol filter loading data for a simulated jet engine test cell aerosol. Final report Jan-Jul 79.** Lundgren, D.A. (Environmental Engineering Consultants, Gainesville, FL (USA)). Aug 1979. Contract F08637-79-M-0784. 44p. NTIS, PC AA03/MF A01.

The Air Force routinely tests turbine engines in fixed test cells, some of which have been cited by state pollution control officials for violations of opacity regulations. A previous theoretical study, CEEDO-TR-78-53, predicted that relatively low efficiency and low cost techniques could bring jet engine test cells into compliance with air pollution regulations. The system proposed included a water cooling spray and a mist eliminator followed by a medium efficiency, high velocity, throw-away type glass filter media. The most serious limitation of which velocity filtration is the aerosol mass loading the potential for rapid pressure drop build up across the filter. Since filter loading characteristics could not be theoretically predicted, the objective of this follow-on work was to experimentally test and report the filter loading characteristics of glass fiber filters for possible application to jet engine test cell exhaust plume opacity control. Two types of glass fiber media were tested: (1) two different medium efficiency pre-filter media, and (2) two different high efficiency final filter media.

ELECTRIC-POWERED SYSTEMS

35114 (DOE/NASA/0048—79/1) **Assessment and preliminary design of an energy buffer for regenerative breaking in electric vehicles.** Buchholz, R.; Mathur, A. (Honeywell, Inc., Minneapolis, MN (USA). Technology Strategy Center). Dec 1979. Contract AI01-77CS51044. 138p. (NASA-CR—159756; TSC—10082-FR). NTIS, PC A07/MF A01.

The original objectives of this program were to: provide an assessment of electric vehicle energy buffers with currently available state of the art, off-the-shelf components, and design, fabricate, and test an engineering model of a selected buffer. The selected buffer was not to include flywheel or electrochemical concepts. A hydropneumatic (liquid and gas) buffer concept was selected for design. The significant components in this buffer are the hydropneumatic accumulator and hydralic motor/pump. Vehicle energy to provide braking is stored compressing gas in the hydropneumatic accumulator with a hydralic pump. Energy is provided during acceleration by discharging the stored energy in the accumulator through the hydraulic motor into the drive train. Detailed analysis of this concept using actual manufacturer-supplied data for weights and efficiencies shows that, compared with a straight electric vehicle, this concept yields only a 5% improvement in range for the electric vehicle when using commercial, currently available motor/pumps and near-term-available lightweight, fiber-wrapped accumulators. Therefore, the design, fabrication, and test portion of the program was terminated. In its place, a hydraulic motor/pump and accumulator study and buffer design effort was conducted to define to what extent product development was necessary to improve the components sufficiently for a usable concept. Lighter-weight, improved-performance motor pumps to be available in 1980 and lighter stronger pressure vessels could result in a 19% improvement in range for electric vehicles.

35115 (PB—80-114036) **Vehicle longitudinal control and reliability project. A review of AGT (automated guideway transit) control and measurement system technology. Volume 2, Part A. Final report.** Petrino, E. (Otis Elevator Co., Denver, CO (USA). Transportation Technology Div.). Jun 1979. Contract DOT-UT-70048. 58p. NTIS, PC A04/MF A01.

The report discusses theoretical and implemented longitudinal control concepts as they apply to four categories of AGT vehicles: shuttle-loop transit, large and small group rapid transit, and personal rapid transit vehicles. This report is organized into two sections. Section 2 describes the theoretical aspects of longitudinal control and briefly describes the longitudinal systems for five state of the art AGT systems. The theoretical control review includes vehicle follower, point follower and fixed block systems along with the control of merging vehicles. Section 3 reviews the options available for measuring vehicle states. The measurement technology review includes sensors for measuring vehicle velocity, position and separation between vehicles. Appendix A of this report provides a classification matrix for ten operational AGT systems.

HYBRID SYSTEMS

35116 (CONS—5157-T1) **Development of evaluation techniques for electrochemical energy storage systems. Final report.** Gaines, L.H.; Nazimek, K. (Exxon Research and Engineering Co., Linden, NJ (USA)). 15 Mar 1980. Contract EM-78-C-01-5157. 93p. NTIS, PC A05/MF A01.

The development of standardized techniques for the comparative evaluation of electric vehicle battery technologies is summarized. The methodology considers both the traditional measures of battery performance (energy density, energy storage costs, and cycle life) and the equally important usage related battery characteristics (probability of technical success, operating and maintenance parameters, and safety/environmental impact). This comparative rationale is supplemented by the ability to generate battery test programs normalized to specific technologies and electric vehicle mission specifications. These test programs allow the evaluation of different battery technologies at comparable levels of electric vehicle performance. It was found that cost optimized electric passenger vehicles will have range specifications of 100 to 110 KM, depending on the specific performance of the battery. Longer range vehicles are penalized by higher first costs while shorter range vehicles suffer from reduced battery life and the need for more frequent alternative car rentals (presumably petroleum fueled) for trips which exceed the EV's range capability.

35117 (DOE/JPL/955187—T1) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report.** Montalenti, P.; Piccolo, R. (Fiat Centro Richerche, Orbassano (Italy)). 21 Sep 1979. Contract NAS-7-100-955187. 142p. NTIS, PC A07/MF A01.

Activities performed in the Near Term Hybrid Vehicle (NTHV) program which studied the technical, economic, and fuel conservation aspects of replacing new 1985 full sized passenger cars in the US with automobiles having combination heat engines and electric motor power are summarized. These studies included NTHV design for the body power units, transmission system, and controls; evaluation of alternative strategies; the fuel conservation expected; goals for vehicle performance, safety and reliability; economic analysis, and mathematical models for use in the computer-aided design of the optimum performance NTHV. (LCL)

35118 (DOE/JPL/955187—T2) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report. Appendix A: mission analysis and performance specification studies. Volume I.** Traversi, M.; Barbarek, L.A.C. (Fiat Centro Richerche, Orbassano (Italy)). 20 Apr 1979. Contract NAS-7-100-955187. 158p. NTIS, PC A08/MF A01.

Studies are described which were performed for the Near Term Hybrid Vehicle program to determine passenger car usage patterns and to correlate these trip mission characteristics with vehicle design and performance specifications. (LCL)

35119 (DOE/JPL/955187—T3) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report. Appendix B: trade-off studies. Volume I.** Traversi, M.; Piccolo, R. (Fiat Centro Richerche, Orbassano (Italy)). 11 Jun 1979. Contract NAS-7-100-955187. 131p. NTIS, PC A07/MF A01.

Trade-off studies of Near Term Hybrid Vehicle (NTHV) design elements were performed to identify the most promising design concept in terms of achievable petroleum savings. The activities in these studies are described. The results are presented as preliminary NTHV body design, expected fuel consumption as a function of vehicle speed, engine requirements, battery requirements, and vehicle reliability and cost. (LCL)

35120 (DOE/JPL/955187—T4) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report. Appendix C: preliminary design data package. Volume I.** Piccolo, R. (Fiat Centro Richerche, Orbassano (Italy)). 31 Jul 1979. Contract NAS-7-100-955187. 259p. NTIS, PC A12/MF A01.

The assumptions made, analysis methods used, and preliminary results of research to determine the design specifications for a hybrid electric-powered and internal combustion engine-powered vehicle that would optimize the fuel economy of passenger automobiles are described. Information is included on body and component design, selection of spark-ignition engine and Ni-Zn batteries, life-cycle costs and life-cycle fuel consumption. (LCL)

35121 (DOE/JPL/955187—T5) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report. Appendix A: mission analysis and performance specification studies. Volume II. Appendices.** Traversi, M.; Barbarek, L.A.C. (Fiat Centro Richerche, Orbassano (Italy)). 18 May 1979. Contract NAS-7-100-955187. 83p. NTIS, PC A05/MF A01.

These appendices to the mission analysis report for the Near Term Hybrid Vehicle program contain data on passenger vehicle usage by purpose, trip length, travel speed, vehicle age, vehicle ownership and fuel economy, and US demographics. (LCL)

35122 (DOE/JPL/955187—T6) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report. Appendix B: trade-off studies. Volume II. Appendices.** Traversi, M.; Piccolo, R. (Fiat Centro Richerche, Orbassano (Italy)). 15 Jun 1979. Contract NAS-7-100-955187. 51p. NTIS, PC A04/MF A01.

These appendices to the Near Term Hybrid Vehicle Trade-off Studies reports present data on the SPEC-78 computer model for simulating vehicle performance, fuel economy, and exhaust emissions; propulsion system alternatives; lead-acid and sodium-sulfur batteries and production cost estimates. (LCL)

35123 (DOE/JPL/955187—T7) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report. Appendix C: preliminary design data package. Volume II. Appendices.** Piccolo, R. (Fiat Centro Richerche, Orbassano (Italy)). 11 Sep 1979. Contract NAS-7-100-955187. 125p. NTIS, PC A06/MF A01.

This appendix to the final report on the Hybrid Passenger Vehicle Development Program contans data on Na-S batteries, Ni-Zn batteries; vehicle body design; tire characteristics; and results of computer simulations of vehicle yaw, pitch, and roll under various driving and aerodynamic conditions. (LCL)

35124 (DOE/JPL/955187—T8) **Near Term Hybrid Passenger Vehicle Development Program. Phase I, Final report. Appendix D: sensitivity analysis.** Traversi, M. (Fiat Centro Richerche, Orbassano (Italy)). 3 Jul 1979. Contract NAS-7-100-955187. 49p. NTIS, PC A03/MF A01.

This report on the Sensitivity of Mission Analysis and Trade-off Studies provides an analysis of the sensitivity of the results of previous mission analysis and performance specification studies to the possible variations of the values of significant parameters as projected to the year 1985. These parameters include vehicle usage by purpose, driving cycles, trip lengths, ownership projections, and life-cycle costs. Tabulated data are included from calculations with variations in these parameters. (LCL)

35125 (DOE/JPL/955188—T1) **Near term hybrid passenger vehicle development program. Phase I. Appendices A and B. Final report.** (Minicars, Inc., Goleta, CA (USA)). Jan 1980. Contract NAS-7-100-955188. 459p. NTIS, PC A20/MF A01.

In this report vehicle use patterns or missions are defined and studied. The three most promising missions were found to be: all-purpose city driving which has the maximum potential market penetration; commuting which requires mainly a two-passenger car; and family and civic business driving which have minimal range requirements. The mission selection process was based principally on an analysis of the travel patterns found in the Nationwide Transportation Survey and on the Los Angeles and Washington, DC origin-destination studies data presented by General Research Corporation in Volume II of this report. Travel patterns in turn were converted to fuel requirements for 1985 conventional and hybrid cars. By this means the potential fuel savings for each mission were estimated, and preliminary design requirements for hybrid vehicles were derived.

35126 (DOE/JPL/955188—T2) **Near term hybrid passenger vehicle development program. Phase I. Appendices C and D. Final report.** (Minicars, Inc., Goleta, CA (USA)). Jan 1980. Contract NAS-7-100-955188. 364p. NTIS, PC A16/MF A01.

The derivation of and actual preliminary design of the Near Term Hybrid Vehicle (NTHV) are presented. The NTHV uses a modified GM Citation body, a VW Rabbit turbocharged diesel engine, a 24KW compound dc electric motor, a modified GM automatic transmission, and an on-board computer for transmission control. The following NTHV information is presented: the results of the trade-off studies are summarized; the overall vehicle design; the selection of the design concept and the base vehicle (the Chevrolet Citation), the battery pack configuration, structural modifications, occupant protection, vehicle dynamics, and aerodynamics; the powertrain design, including the transmission, coupling devices, engine, motor, accessory drive, and powertrain integration; the motor controller; the battery type, duty cycle, charger, and thermal requirements; the control system (electronics); the identification of requirements, software algorithm requirements, processor selection and system design, sensor and actuator characteristics, displays, diagnostics, and other topics; environmental system including heating, air conditioning, and compressor drive; the specifications, weight breakdown, and energy consumption measures; advanced technology components, and the data sources and assumptions used. (LCL)

35127 (DOE/JPL/955188—T3) **Near term hybrid passenger vehicle development program. Phase I. Final report.** (Minicars, Inc., Goleta, CA (USA)). Jan 1980. Contract NAS-7-100-955188. 139p. NTIS, PC A07/MF A01.

Activities in Phase I of a program to develop a preliminary design of a hybrid (electric and internal combustion engine powered) vehicle are summarized. After analyzing automobile usage in terms of trip lengths and purposes, the petroleum savings that could result from using hybrid versus conventional passenger vehicles were estimated. Using a modified General Motors X-body car (Citation) as the base vehicle, the preliminary design of the vehicle, the power train, including internal combustion engine, batteries, and transmission, and the electronic control system are described. The reliability and safety, life cycle costs, and computerized simulation of vehicle performance are discussed. From this study it is concluded that hybrid vehicles are best suited for short range driving; the life cycle cost of the preliminary design near term HV is 25% higher than that for a ICE vehicle; the availability of essential materials such as battery leads needs investigation; and further evaluation of the effects of acute petroleum shortages as well as increased fuel prices and of the desirability of various sizes of HV's is required. (LCL)

35128 (DOE/JPL/955189—T1) **Design tradeoff studies and sensitivity analysis. Appendix B.** (South Coast Technology, Inc., Santa Barbara, CA (USA)). 25 May 1979. Contract NAS-7-100-955189. 234p. NTIS, PC A11/MF A01.

The results of the design trade-off studies and the sensitivity analysis of Phase I of the Near Term Hybrid Vehicle (NTHV) Program are presented. The effects of variations in the design of the vehicle body, propulsion systems, and other components on vehicle power, weight, cost, and fuel economy and an optimized hybrid vehicle design are discussed. (LCL)

35129 (SRD—79-134/1) **Near-Term Hybrid Vehicle Program. Final report, Phase I.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 8 Oct 1979. Contract NAS-7-100-955190. 138p. NTIS, PC A07/MF A01.

This report is the summary report of a series which documents the results of Phase I of the Near-Term Hybrid Vehicle Program. This phase of the program was a study leading to the preliminary design of a 5-passenger hybrid vehicle utilizing two energy sources (electricity and gasoline/diesel fuel) to minimize petroleum usage on a fleet basis. A complete summary of the work done on Phase I is presented in the following segments: overall summary of the Phase I activity; summary of the individual tasks; summary of the hybrid vehicle design; summary of the alternative design options; summary of the computer simulation; summary of the economic analysis; summary of the maintenance and reliability considerations; summary of the design for crash safety; and bibliography. These summaries are based on and are supported by the series of task reports that were submitted as deliverable items during the contract.

35130 (SRD—79-134/2) **Near-Term Hybrid Vehicle Program. Final report. Phase I, Appendix A: mission analysis and performance. Specification studies report.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 8 Oct 1979. Contract NAS-7-100-955190. 118p. NTIS, PC A06/MF A01.

This Mission Analysis and Performance Specification Studies Report documents part of the results of Phase I of the Near-Term Hybrid Vehicle Program. Phase I of the program was a study leading to the preliminary design of a five-passenger hybrid vehicle utilizing two energy sources (electricity and gasoline/diesel fuel) to minimize petroleum usage on a fleet basis. This report presents the study methodology; the vehicle characterizations; the mission description, characterization, and impact on potential sales; the rationale for the selection of the Reference Internal Combustion Engine (ICE) Vehicle, the primary results; and conclusions and recommendations of the mission analysis and performance specification report.

35131 (SRD—79-134/3) **Near-Term Hybrid Vehicle Program. Final report. Phase I, Appendix B: design trade-off studies report. Volume I. Design trade-off studies.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 8 Oct 1979. Contract NAS-7-100-955190. 193p. NTIS, PC A09/MF A01.

Design trade-off studies were made to determine the relative attractiveness of various hybrid/electric power train configurations and electrical and mechanical drive-line components. Initial screening of the candidate configurations and components was done using a vehicle synthesis computer program. The initial screening was concerned primarily with total vehicle weight and economic factors and identified the hybrid power train combinations which warranted detailed evaluation over various driving cycles. This was done using a second-by-second vehicle simulation program which permitted the calculations of fuel economy, electricity usage, and emissions as a function of distance traveled in urban and highway driving. Vehicle layout studies were also made to evaluate various power train arrangement possibilities in terms of their effect on vehicle handling, safety, serviceability, and passenger comfort. Based on the design trade-off studies, the power train layouts and components were selected for the Preliminary Design Task of the Near-Term Hybrid Vehicle Program.

35132 (SRD—79-134/4) **Near-Term Hybrid Vehicle Program. Final report. Phase I, Appendix B: design trade-off studies report. Vol II, supplement to design trade-off studies.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 8 Oct 1979. Contract NAS-7-100-955190. 311p. NTIS, PC A15/MF A01.

Volume II, Supplement to Design Trade-Off Studies Report Volume I reports on work done on Task 2 and is part of a series which documents the results of Phase I of the Near-Term Hybrid Vehicle Program. Phase I was a study leading to the preliminary design of a five-passenger vehicle utilizing two energy sources (electricity and gasoline/diesel fuel) to minimize petroleum usage on a fleet basis. Reports submitted by subcontractors on: Heat Engine Trade-Off Study; Assessment of Battery Power Sources; and Vehicle Technology are reproduced. Material from a number of internal General Electric studies is summarized. These include pertinent studies of the: Proposed Development Program on Advanced Electric Vehicle; Centennial Electric Car; Electric Vehicle ac Drive Study; Propulsion System Design Trade-off Studies; Producibility Analysis; and Required Motor and Controller Data.

35133 (SRD—79-134/5) **Near-Term Hybrid Vehicle Program. Final report. Phase I, Appendix B: design trade-off studies report. Volume III. Computer program listings.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 8 Oct 1979. Contract NAS-7-100-955190. 112p. NTIS, PC A06/MF A01.

This Volume reports on work done on Task 2 and is part of the final summary report of a series which documents the results of Phase I of the Near-Term Hybrid Vehicle Program. This phase of the program was a study leading to the preliminary design of a five-passenger hybrid vehicle utilizing two energy sources (electricity and gasoline/diesel fuel) to minimize petroleum usage on a fleet basis. This volume contains a description and listing of two computer programs: Hybrid Vehicle Design Program (HYVELD) and Hybrid Vehicle Simulation Program (HYVEC). Both of the programs are modifications and extensions of similar programs developed at JPL as part of the Electric and Hybrid Vehicle System Research and Development Project, Hybrid Vehicle Potential Assessment, and Hybrid Vehicle System Evaluation Tasks.

35134 (SRD—79-134/6) **Near-Term Hybrid Vehicle Program. Final report. Phase I, Appendix C: preliminary design data package.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 8 Oct 1979. Contract NAS-7-100-955190. 199p. NTIS, PC A09/MF A01.

The preliminary design data package for the Electric and Hybrid Vehicle (EHV) program is presented. Information is included on: design methods and rationale; detailed vehicle design; advanced technology developments; safety and comfort analysis; and the design and operation of a microcomputer system for controlling vehicle propulsion. (LCL)

EMISSION CONTROL

REFER ALSO TO CITATION(S) 35111

35135 (DOE/BETC/RI—80/7) **Exhaust and evaporative emissions from gasohol-type fuels.** Naman, T.M.; Allsup, J.R. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Aug 1980. 13p. NTIS, PC A02/MF A01.

An experimental study was conducted at the US Department of Energy's Bartlesville (Okla.) Energy Technology Center in cooperation with the Environmental Protection Agency to determine the characteristics of gasohol-type fuels with respect to exhaust and evaporative emissions. Five fuels, 2 gasolines (reference and commercial unleaded) and 3 gasohols (90% gasoline/10% ethanol) were tested in a fleet of 10 late-model automobiles. Six were equipped with oxidation catalysts and 4 were equipped with three-way catalysts. The results obtained from the 1978 Federal test procedure indicate that the addition of ethanol to the base gasoline, whether it is a reference fuel (Indolene) or a commercial fuel, has measurable effects on exhaust and evaporative emissions. However, on the average, the magnitude of these effects was generally within the 1978 emission standards established by the EPA. More specifically, the addition of ethanol, in the case of vehicles with oxidation catalysts, decreased hydrocarbons by an average of 27%, decreased carbon monoxide by 43%, decreased volumetric fuel economy by 3%, and increased oxides of nitrogen by 16%. Evaporative emissions were increased by 40%. In the case of vehicles with three-way catalysts, the addition of ethanol to the base fuel, on the average, decreased carbon monoxide by 7%, decreased fuel economy by 5%, increased hydrocarbons by 12%, increased oxides of nitrogen by 7%, and increased evaporative emissions by 49%.

35136 (PB—80-119746) **Case study of the innovation process characterizing the development of the three-way catalytic converter system. Final report, April-December 1978.** Dexter, D. (Lexington Technology Associates, MA (USA)). Nov 1979. Contract DOT-TSC-1355. 52p. NTIS, PC A04/MF A01.

This report traces the development of the three-way catalytic converter system from its origins in automaker and chemical firm research in the 1950s, to present plans preparing the system to be the auto exhaust emission control device most widely used on American cars in the 1980s. Multiple forces led to the decision by major automakers in the late 1970s to adopt the system. Among these forces were tightening exhaust emissions regulations; the development of low-cost, mass-producible system components; and institutional factors including strong system advocates, internationalization of the auto industry, and the desire of certain technology-oriented automakers to defend their U.S. market shares by adoption of the system. The paper concludes that the three-way converter system may become the dominant auto exhaust emission control device for American-market cars in the 1980s if problems relating to adoption of the system to 6 and 8 cylinder engines, reduction in requirements for precious metals, and the development of secure sources of supply for those metals are resolved.

35137 (PB—80-121551) **Characterization of sulfates, odor, smoke, pom and particulates from light and heavy duty engines. Part IX. Final report, 6 July 1976-20 October 1978.** Springer, K.J. (Southwest Research Inst., San Antonio, TX (USA)). Jun 1979. Contract EPA-68-03-2417. 533p. NTIS, PC A23/MF A01.

This report expands EPA's data base on regulated and unregulated emissions from Diesel powered cars and trucks. To the extent possible, comparisons were made to similar vehicles powered by gasoline fueled engines. Emissions, fuel economy and general performance of a pair of gasoline- and Diesel-powered Volkswagen Rabbit and Oldsmobile Cutlass cars are discussed. Characterization of heavy-duty engines included a Mack ETAY(B)673A and a Caterpillar 3208, both Diesels, and a Chevrolet 366 gasoline fueled engine. A pair of Daimler-Benz Diesels, one turbocharged and the other not, were used to evaluate the effect of turbocharging. A high pressure injection system was tried with the Mack engine and compared to the standard system. A Caterpillar 3406 Diesel was used to investigate the effect of injection timing, combustion system and exhaust gas recirculation on exhaust particulate and other emissions.

35138 (PB—80-125602) **Light duty vehicle and light duty truck emission performance warranty; short tests and standards. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA). Inspection and Maintenance Staff). Dec 1979. 27p. NTIS, PC A03/MF A01.

This report adresses the relationship between short test emission results and emissions as measured on the 'complete' or certification test (hydrocarbons and carbon monoxide) for 1981 and later model year light duty vehicles and light duty trucks. As provided in section 207(b) of the Clean air Act, EPA must establish an Emissions Performance Warranty if a short test can be developed which is (1) available (2) in accordance with good engineering practice and (3) reasonably capable of being correlated with the Federal Test Procedure (FTP). The purpose of this report is to evaluate the correlation of idle and loaded short test emissions to results which will be obtained on the certification test for 1981 model year and later passenger cars and light trucks. This report addresses the issue of correlation for 1981 and later model year vehicles, Data from 1975-77 model federal cars was examined. Three short tests are recommended: idle, two speed idle and two mode loaded. These short tests are associated standards give approximately the same error of commission rate as the FTP (comparing single test results to average emission levels) while identifying a substantial part of the excess emissions.

CARBON MONOXIDE

35139 (PB—80-120678) **Heavy-duty engine baseline program (1969) and 1983 emission standards development. Technical report (final).** Cox, T.P.; Passavant, G.W.; Ragsdale, L.D. (Environmental Protection Agency, Ann Arbor, MI (USA)). May 1979. 109p. NTIS, PC A06/MF A01.

The U.S. EPA was Mandated by the 1977 Clean Air Act Amendments to determine revised HC and CO emission standards for 1983 model year heavy duty engines. These revised emission standards were to be based on a 90% reduction from the average of actually measured emissions from uncontrolled (1969 model year) gasoline-fueled engines. To comply with the provisions of the 1977 CAAA, ECTD began a baseline testing program. Under this program, in-use 1969 model year heavy-duty gasoline fueled engines were procured, brought to manufacturer's specifications, and then were tested for emissions using the transient test procedure and idle test procedure. The text of this report discusses the vehicle/engine selection and procurement efforts, as well as the engine preparation and testing programs. It also includes a presentation and discussion of the 1969 emissions data.

HYDROCARBONS

REFER ALSO TO CITATION(S) 35139

35140 (DOE/ET/15303—T3) **HC quench layer formation in combustion processes. Technical progress report, September-December 1979.** Lavoie, G.A. (Ford Motor Co., Dearborn, MI (USA)). Feb 1980. Contract AC03-79ET15303. 9p. NTIS, PC A02/MF A01.

The project is aimed at understanding wall quenching and other processes responsible for surface generated hydrocarbons in combustion under engine-like conditions. The study concerns the effects of turbulence on the evolution of hydrocarbons. At the conclusion of the program, significant new experimental information will have been generated and an analytical model of the fluid mechanics and some aspects of the chemistry of quenching will be formulated. The work is divided into three tasks: (1) combustion bomb experiments to measure the effect of turbulence on the chemical species near the cold surface; combustion bomb experiments, using a similar turbulence generating device, to fully characterize the flow and turbulence in the vicinity of the quenching surface, and an analytical study to characterize fluid mechanical scales of interest in the boundary layer and to find an analytical solution to describe the evolution of the layer. The major accomplishments to date are (i) demonstration of the feasibility of single shot sampling valve operation and gas analysis in the Ford bomb under laminar combustion conditions, (ii) formulation of design rationale for turbulence generation scheme and bomb geometry, and (iii) formulation of an approach to modeling turbulent boundary layer conditions.

35141 (DOE/ET/15303—T4) **HC quench layer formation in combustion processes. Technical progress report, January-April 1980.** Lavoie, G.A. (Ford Motor Co., Dearborn, MI (USA). Fuels and Lubricants Dept.). Jun 1980. Contract AC03-79ET15303. 17p. NTIS, PC A02/MF A01.

The project is aimed at understanding wall quenching and other processes responsible for surface generated hydrocarbons in combustion under engine-like conditions. The study concerns the effects of turbulence on the evolution of hydrocarbons. At the conclusion of the program, significant new experimental information will have been generated and an analytical model of the fluid mechanics and some aspects of the chemistry of quenching will be formulated. The work is divided into three tasks: (1) combustion bomb experiments to measure the effect of turbulence on the chemical species near the cold surface; (2) combustion bomb experiments using a similar turbulence generating device, to fully characterize the flow and turbulence in the vicinity of the quenching surface; and (3) an analytical study to characterize fluid mechanical scales of interest in the boundary layer and to find an analytical solution to describe the evolution of the layer. Significant areas of progress during the reporting period are: (1) the sampling valve data obtained previously in the Ford spherical bomb under quiescent firing conditions have been analyzed and interpreted; (2) the solenoid-operated charging system has been set up to generate turbulence in the bomb, and the inlet flow has been characterized in terms of pressure, velocity, turbulence, and temperature histories; and (3) an analysis leading to a simplified model for the turbulent quench layer has been obtained.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 35109, 35135

MATERIALS

REFER ALSO TO CITATION(S) 35376

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 34461, 34462, 34463, 34617, 35027, 35771

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 34923, 35158

35142 Site and nature of H bonding on Ti (0001). Feibelman, P.J.; Hamann, D.R.; Himpsel, F.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1734-1739(15 Aug 1980).

The site and nature of the bonding of H at a Ti (0001) surface are established via the analysis of new angle-resolved photoemission measurements by self-consistent electronic-structure calculations. Experimentally observed H-induced surface states are identified with calculated bonding and antibonding combinations of H 1s and Ti 3d,4s orbitals. The positions of these levels are strongly dependent on local bonding geometry. The H site which minimizes the total energy gives a very good account of the observed spectrum. Ignoring the total energy leads to a more ambiguous structure determination.

35143 Sputter target. Gates, W.G.; Hale, G.J. (to Dept. of Energy). US Patent 4,209,375. 24 Jun 1980. Filed date 2 Aug 1979. 4p.

PAT-APPL-63,008.

The disclosure relates to an improved sputter target for use in the deposition of hard coatings. An exemplary target is given wherein titanium diboride is brazed to a tantalum backing plate using a gold-palladium-nickel braze alloy. 8 claims.

35144 Thin film deposition by electric and magnetic crossed-field diode sputtering. Welch, K.M. (to Dept. of Energy). US Patent 4,209,552. 24 Jun 1980. Filed date 18 Dec 1978. 10p.

PAT-APPL-970,844.

Applying a thin film coating of titanium nitride to a klystron window by means of a crossed-field diode sputtering array is described. The array is comprised of a cohesive group of numerous small hollow electrically conducting cylinders and is mounted so that the open ends of the cylinders on one side of the group are adjacent to a titanium cathode plate. The workpiece is mounted so as to face the open ends of the other side of the group. A magnetic field is applied to the array so as to be coaxial with the cylinders and a potential is applied across the cylinders and the cathode plate. The cylinders are an anode being positive with respect to the cathode plate. The cylinders, the cathode plate and the workpiece are situated in an atmosphere of nitrogen which becomes ionized by field emission because of the electric field between the cylinders and cathode plate, thereby establishing an anode-cathode discharge that results in sputtering of the titanium plate. The sputtered titanium coats the workpiece and chemically combines with nitrogen to form a titanium nitride coating. 6 claims.

35145 Method using laser irradiation for the production of atomically clean crystalline silicon and germanium surfaces. Ownby, G.W.; White, C.W.; Zehner, D.M. US Patent Application 108,199. 28 Dec 1979. 20p.

This invention relates to a new method for removing surface impurities from crystalline silicon or germanium articles, such as off-the-shelf p- or n-type wafers to be doped for use as junction devices. The principal contaminants on such wafers are oxygen and carbon. The new method comprises laser-irradiating the contaminated surface in a non-reactive atmosphere, using one or more of Q-switched laser pulses whose parameters are selected to effect melting of the surface without substantial vaporization thereof. In a typical application, a plurality of pulses is used to convert a surface region of an off-the-shelf silicon wafer to an atomically clean region. This can be accomplished in a system at a pressure below 10^{-8} Torr, using Q-switched ruber-laser pulses having an energy density in the range of from about 60 to 190 MW/cm^2.

35146 Superconducting wire with improved strain characteristics. Luhman, T.; Klamut, C.J.; Suenaga, M.; Welch, D. US Patent Application 105,439. 19 Dec 1979. 18p.

A superconducting wire comprising a superconducting filament and a beryllium strengthened bronze matrix in which the addition of beryllium to the matrix permits a low volume matrix to exhibit reduced elastic deformation after heat treating which increases the compression of the superconducting filament on cooling and thereby improve the strain characteristics of the wire.

35147 Characteristics of as-cast and subcritically heat-treated high-chromium-molybdenum white irons for thick-section castings. Parks, J.L. Greenwich, CT; Climax Molybdenum Company (1978). 11p.

The hardness, microstructure, abrasive wear resistance and mechanical properties were evaluated for four high-chromium-molybdenum irons in the as-cast condition and after various subcritical heat treatments. After pouring, the irons were cooled to simulate the mold cooling rates in either 100- or 150-mm (4- or 6-in.) -thick plates. Compositions were chosen to provide matrix microstructures which did not contain ferrrite-carbide transformation products in the mold-cooled condition. When cast and cooled as thick sections, matrix microstructures of the as-cast high-chromium-molybdenum irons contained austenite and significant quantities of martensite. Hardness of the as-cast austenitic-martensitic irons was higher than the hardness obtained for predominantly austenitic irons cast in thinner section sizes. Hardness of the irons increased after subcritical heat treatment at around 500°C (930°F). As-cast and subcritically heat-treated thick-section irons exhibited excellent abrasion resistance similar to that exhibited by martensitic (fully heat treated) high-chromium-molybdenum irons. Mechanical properties of the austeni-

tic-martensitic irons were also comparable to those typically exhibited by martensitic high-chromium-molybdenum irons.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 35152, 35773

35148 (CONF-800744—7(Draft)) **Evidence of surface migration and formation of catalytically inactive Pt in corrosion studies of Pt^+ implanted Ti.** Appleton, B.R.; Kelly, E.J.; White, C.W.; Thompson, N.G.; Lichter, B.D. (Oak Ridge National Lab., TN (USA); Vanderbilt Univ., Nashville, TN (USA)). Aug 1980. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

From Ion beam modification of materials conference; Albany, NY, USA (14 Jul 1980).

This investigation is part of an ongoing research project directed at applying the techniques of ion implantation doping and ion scattering analysis to identify the mechanisms associated with the anodic dissolution of Ti-Pt alloys. The Ti-Pt alloys produced by ion implantation were electrochemically examined in hydrogen saturated 1 N H_2SO_4 by both potentiostatic polarization and open-circuit potential methods. In this study, Ti samples implanted to relatively high doses (5.4×10^{15} to 2.9×10^{16} atoms/cm^2) were examined by ion scattering analysis at various stages in the electrochemical measurements. Quantitative measurements showed that the majority of the implanted Pt accumulated on the surface during anodic dissolution and underwent large scale surface migration. Evidence is also presented for the transition of the Pt on the surface from a catalytically active to inactive state. Possible mechanisms for the observed catalytically inactive Pt are discussed.

35149 (CONF-8005109—1(Draft)) **Grain boundary segregation and intergranular failure.** White, C.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-EN-26; AC05-76OR00033. 65p. NTIS, PC A04/MF A01.

From International Al-Li conference; Stone Mountain, GA, USA (19 May 1980).

Trace elements and impurities often segregate strongly to grain boundaries in metals and alloys. Concentrations of these elements at grain boundaries are often 10^3 to 10^5 times as great as their overall concentration in the alloy. Because of such segregation, certain trace elements can exert a disproportionate influence on material properties. One frequently observed consequence of trace element segregation to grain boundaries is the occurrence of grain boundary failure and low ductility. Less well known are incidences of improved ductility and inhibition of grain boundary fracture resulting from trace element segregation to grain boundaries in certain systems. An overview of trace element segregation and intergranular failure in a variety of alloy systems as well as preliminary results from studies on Al 3% Li will be presented.

35150 (COO—5002-10) **Simulation of the structure of vacancies in high angle grain boundaries.** Bristowe, P.D.; Brokman, A.; Spaepen, F.; Balluffi, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jun 1980. Contract AS02-78ER05002. 9p. NTIS, PC A02/MF A01.

Since the modeling approach used in an earlier work is used at an atomic level, this is the most appropriate and reliable technique available. To complement this study, however, we have also employed a hard sphere dynamic model and a bubble raft model because in the past they have provided useful qualitative insight into the structure of a variety of defects in two-dimensional crystalline and amorphous systems. The computed results form part of a wider investigation of vacancies and interstitials in various grain boundaries in which the binding energies are analyzed and related to the defect structure and form of the interatomic potential.

35151 Calculation of host nuclear relaxation in dilute kondo alloys for T << T/sub k/. Simanek, E.; Yoksan, S. (Univ. of California, Riverside). *Solid State Commun.;* **27**: 287-289(1978).

A microscopic calculation is presented of the host nuclear spin-lattice relaxation rate as a function of impurity-host distance r for dilute kondo alloys at T << T/sub k/. The net relaxation rate involves two main parts. One, dependent upon the local conduction electron density of states, exhibits kinematic oscillations which are due to resonant scattering. The other part, due to the impurity spin fluctuations, is shown to dominate the first mechanism allowing the Korringa relation to hold in systems with low T/sub k/ (such as Cu:Fe). In Al:Mn both mechanisms are of equal importance, and the net host relaxation rate and the excess Knight shift do not satisfy a Korringa relation.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 34897, 34920, 35143, 35146, 35147, 35172, 35820, 35833, 35836

35152 (CONF-790910—6) **Boron segregation to grain boundaries and improved ductility in Pt + 30 wt % Rh + 8 wt % W.** White, C.L.; Keiser, J.R.; Braski, D.N. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From Symposium on calculation of phase diagrams and thermochemistry; Milwaukee, WI, USA (17 Sep 1979).

Portions of document are illegible.

Boron additions of up to 75 wt ppM have been observed to improve the room temperature strength and ductility of a Pt + 30 wt % Rh + 8 wt % W alloy. Alloys without boron fail intergranularly, and those with 75 wt ppM boron added fail in a mixed intergranular-transgranular mode. Auger electron spectroscopy on intergranular fracture surfaces indicated that boron segregates strongly to grain boundaries in the boron doped alloys. Transmission electron microscopy of alloys with and without boron indicated that both were free of internal precipitates. The observed improvements in strength and ductility appear to be related to boron enrichment within a few atomic distances of the grain boundary.

35153 (CONF-800907—2) **Progress toward analytical description of the creep strain-time behavior of engineering alloys.** Booker, M.K. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

From Aspects of creep conference; Sheffield, UK (Sep 1980).

Elevated-temperature design methods in the United States often require a comprehensive description of the properties of the construction materials. These descriptions include representations for creep strain-time behavior as a function of stress, temperature, and material variability. Work conducted at this laboratory in the past five years toward the development of analytical techniques to derive such representations is summarized. Results for several common elevated-temperature structural materials are presented to illustrate the techniques.

35154 Shear strength of shock-loaded polycrystalline tungsten. Asay, J.R.; Chhabildas, L.C.; Dandekar, D.P. (Sandia Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *J. Appl. Phys.;* **51**: No. 9, 4774-4783(Sep 1980).

Previous experiments have suggested that tungsten undergoes a significant loss of shear strength when shock loaded to stresses greater than 7 GPa. In order to investigate this effect in more detail, a series of experiments was conducted in which polycrystalline tungsten was first shock loaded to approximately 10 GPa and then either unloaded or reloaded from the shocked state. Analysis of measured time-resolved wave profiles indicates that during initial compression to 9.7 GPa, the shear stress in polycrystalline tungsten increases to a maximum value of 1.1 GPA near a longitudinal stress of 5 GPa, but decreases to a final value of 0.8 GPa for stresses approaching 10 GPa. During reloading from a longitudinal stress of 9.7 GPa to a final value of ~14 GPa, the shear stress increases to a peak value of 1.2 GPa and softens to 1.0 GPa in the final state. During unloading from the shocked state, the initial response is elastic with a strong Baushinger effect. Examination of a recovered sample shows evidence for both deformation slipping and twinning, which may be responsible for the observed softening.

35155 Equation of state from weak shocks in solids. Wallace, D.C. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1495-1502(15 Aug 1980).

The Rankine-Hugoniot jump conditions for the increases across a shock of the normal stress, normal strain, and internal energy are not valid for weak shocks in solids. Correct jump equations for a solid can be obtained by integrating the equations for conservation of mass, momentum, and energy along the Rayleigh line through the shock process; these jump equations then depend on the details of the shock profile. Further, because a uniaxially compressed solid supports a nonzero shear stress, the locus of thermodynamic states reached behind planar shocks, which we call the anisotropic Hugoniot, requires for its description two stress variables and two strain variables. In the present paper the thermodynamic description of the anisotropic Hugoniot is given, and for the example of 6061-T6 Al the shock-profile jump equations are derived, the weak-shock equation of state is computed, and the pressure on the principal adiabat is found to differ from the results of Rankine-Hugoniot theory by several percent in the range 0 —100 kbar.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 35826, 35829

35156 (CONF-800928—5(Draft)) **High sensitivity leed analyses for clean metallic surfaces.** Noonan, J.R.; Davis, H.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

Results obtained from LEED analyses of CU(100) and Ag(110) are outlined and discussed. Particulafr emphasis has been placed on the sensitivity of the analyses to variations in both the experimental data base and the nonstructural parameters used in calculations. The sensitivity of the analyses has been improved by using a technique where nonspecular I-V profiles, collected at normal incidence, were averaged over their symmetrically equivalent set. Using such averaged data, it was found that the analyses are sensitive to changes in atomic positions of the order of 2 pm (0.02 A). Although this result has been obtained for clean metallic systems, it is believed to be generally applicable to other surface systems.

35157 (COO—4381-10) **Study of roughness-induced diffuse and specular reflectance at silver-air and silver-liquid interfaces. Final report, July 1, 1979-August 31, 1980.** Sari, S.O. (Oregon State Univ., Corvallis (USA)). Jul 1980. Contract AS02-77ER04381. 48p. NTIS, PC A03/MF A01.

Results of an extended investigation of surface plasma-wave absorption and roughness-induced optical scattering from an interface of silver and air are described. In particular, the position of the surface plasma resonance minimum in reflectivity for a stochastically roughened metal silver surface has been studied as a function of a number of distinct roughness perturbations. In the case of a transparent liquid-silver boundary the frequency red shift of the resonance minimum has been determined and the location of the surface plasmon dip for various liquids is shown to agree well with a simple roughness theory. The additional interfacial properties due to the formation of a thin inhomogeneous oxide layer occurring either spontaneously or due to application of a small interfacial electrical potential are more complex. However, the optical constants of the interlayer have been determined from differential specular reflectance measurements at the boundary. Nodule size parameters determined from scattering and absorption measurements and features of both polarized and depolarized diffuse reflectance give further information on the state of the interface. Reflectance of ordered-corrugated surfaces are also described.

35158 (IS—4722) **Electrotransport of solutes in refractory metals. Final report, October 1, 1978-December 14, 1979.** Schmidt, F.A.; Carlson, O.N.; Beck, M.S.; Rehbein, D.K.; Williams, D.E. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 31p. NTIS, PC A03/MF A01.

The electric mobilities, diffusivities and effective valences were determined for molybdenum, rhenium, tungsten and zirconium in β-thorium. All four solutes migrated in the same direction as the electron flow. Rhenium and molybdenum were found to be very mobile with tungsten somewhat slower. Zirconium was found to move at a rate near that of the self-diffusion of β-thorium, viz., approximately two orders of magnitude slower than rhenium and tungsten. The electromigration velocities showed a similar trend. Comparison was made between experimental data obtained by laser ion mass spectrometry and theoretical transport equations for two purification experiments. Good agreement was obtained with both the concentration profile predicted by DeGroot and the purification ratio predicted by Verhoeven.

35159 (IS-M—283) **Magnetostriction of laves phase rare earth - Ni_2 compounds.** Abbundi, R.; Clark, A.E.; McMasters, O.D. (Naval Surface Weapons Center, Silver Spring, MD (USA); Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 9p. (CONF-8004112—1). NTIS, PC A02/MF A01.

From Intermag conference; Boston, MA, USA (21 Apr 1980).

The magnetostriction of the RNi_2 compounds (R = Tb, Dy, Ho, Er and Tm) was measured as a function of applied field from T = 5°K to above the Curie temperatures. A direct comparison is made between these results and the huge magnetostriction observed at cryogenic temperatures in the RFe_2 and RCo_2 compounds. The largest magnetostriction in the RNi_2 series occurs in the $TbNi_2$. At T = 5°K the magnetostriction is fairly well saturated and results in a value of λ/sub parallel to/-λ/sub perpendicular to/$\lambda = 2270 \times 10^{-6}$ at H = 25kOe, while extrapolation to infinite field yields 2340 x 10^{-6}. $DyNi_2$ also displays a tendency to saturate at the higher fields at lower temperatures with λ/sub parallel to/-λ/sub perpendicular to/ = -765 x 10^{-6} at 25 kOe and - 840 ppM at H = ∞. The compounds $HoNi_2$, $ErNi_2$ and $TmNi_2$ all exhibit large strains at T = 5°K although fail to saturate with available fields. At 25kOe the magnetostriction for these compounds was found to be -386 x 10^{-6}, -415 x 10^{-6} and - 552 x 10^{-6} respectively.

35160 (IS-M—294) **Pressure dependence of the superconducting transition temperature of (Th/sub 1-x/Y/sub x/)Rh_4B_4.** Vining, C.B.; Shelton, R.N. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 11p. (CONF-800954—1). NTIS, PC A02/MF A01.

From Ternary superconductors conference; Lake Geneva, WI, USA (24 Sep 1980).

The pressure dependence of the superconducting transition temperatures, T/sub c/'s, of fourteen samples in the pseudoternary system (Th/sub 1-x/Y/sub x/)Rh_4B_4 are reported for hydrostatic pressures up to 21 kbar. The Y rich samples show an enhancement of T/sub c/ with applied pressure, whereas for the Th rich compounds T/sub c/ is depressed by pressure. A broad plateau in dT/sub c//dp as a function of x is observed for nearly equiatomic ($0.4 \leqq x \leqq 0.80$) compositions. The non-linear behavior of T/sub c/ as a function of pressure for the Y rich samples ($x > 0.80$) is discussed with reference to prior measurements on YRh_4B_4. Observation of this nonlinearity may be related to the purity of the Y source material or the presence of a pressure-induced phase transformation.

35161 (LBL—11393) **Physical and optical properties of rare earth cobalt magnets.** Halbach, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 27p. (CONF-800952—1). NTIS, PC A03/MF A01.

From International conference on charged particle optics; Giessen, F.R. Germany (8 Sep 1980).

Rare Earth Cobalt (REC) permanent magnets have unique properties that permit solutions to some optical tasks that cannot be accomplished with conventional magnets. A review of design and of performance characteristics of these magnets includes an analytical description of the three dimensional fringe fields of REC quadrupoles.

35162 **Photoemission investigation of the temperature effect on Si—Au interfaces.** Abbati, I.; Braicovich, L.; Franciosi, A.; Lindau, I.; Skeath, P.R.; Su, C.Y.; Spicer, W.E. (Instituto di Fiscia del Politecnico, Milano, Italy). *J. Vac. Sci. Technol.;* **17**: No. 5, 930-935(Sep 1980).

We report extensive photoemission measurements carried out with synchrotron radiation and with conventional light sources on Si(111)—Au interfaces. The coverage dependence has been studied in detail at room temperature (RT) with synchrotron radiation. We have found considerable intermixing at all coverages, and the photoemission spectrum characteristic for pure gold was not even observed at coverages of about 150 monolayers. A deeper insight into the intermixing mechanism is obtained from the te,perature dependence of the spectra, which was studied for surfaces covered with 10 monolayers. Considerable intermixing is observed for interfaces prepared and measured at liquid nitrogen temperatures (LNT). Several hours of annealing at RT are required for an interface prepared at LNT to obtain the equilibrium situation reached immediately after preparation at RT. These results indicate that the thermal energy of the sample is not the only energy responsible for intermixing during interface preparation. We propose that an important contribution comes from the condensation energy of gold. The photoemission spectra show that the intermixing increases with the temperature up to ≃350°C.

35163 **Flow process of weak shocks in solids.** Wallace, D.C. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1487-1494(15 Aug 1980).

Experimental measurements of weak-shock profiles in the alloy 6061-T6 Al are analyzed by irreversible-thermodynamic finite-strain theory to obtain a complete description of the flow process through the shock compression, including the entropy production and the relations among the flow variables of shear stress, plastic strain, and plastic strain rate. The primary quantities, the normal stress and the normal strain, are determined entirely from the equations of motion and the shock-profile data; the secondary quantities, the shear stress, plastic strain, temperature, and entropy, are then determined by thermodynamics. It is shown that infinitesimal strain theory gives unreliable results as soon as the plastic strain becomes of the same order of magnitude as the elastic strain.

35164 **Electronic-structure studies of the Nb (110) surface.** Smith, R.J.; Williams, G.P.; Colbert, J.; Sagurton, M.; Lapeyre, G.J. (Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1584-1588(15 Aug 1980).

The electronic structure of the Nb (110) surface is studied using angle-resolved photoemission. The properties of the Σ_1 band crossing at the Fermi energy are examined in detail. A comparison is made with similar measurements for Mo (110) to evaluate the validity of a rigid-band approximation. The final states along Σ are also studied using synchrotron radiation as a source.

35165 **Self-consistency and sum-rule tests in the Kramers-Kronig analysis of optical data: Applications to aluminum.** Shiles, E.; Sasaki, T.; Inokuti, M.; Smith, D.Y. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1612-1628(15 Aug 1980).

An iterative, self-consistent procedure for the Kramers-Kronig analysis of data from reflectance, ellipsometric, transmission, and electron-energy-loss measurements is presented. This procedure has been developed for practical dispersion analysis since experimentally no single optical function can be readily measured over the entire range of frequencies as required by the Kramers-Kronig

relations. The present technique is applied to metallic aluminum as an example. The results are then examined for internal consistency and for systematic errors by various optical sum rules. The present procedure affords a systematic means of preparing a self-consistent set of optical functions provided some optical or energy-loss data are available in all important spectral regions. The analysis of aluminum discloses that currently available data exhibit an excess oscillator strength, apparently in the vicinity of the L edge. A possible explanation is a systematic experimental error in the absorption-coefficient measurements resulting from surface layers: possibly oxides: present in thin-film transmission samples. A revised set of optical functions has been prepared by an ad hoc reduction of the reported absorption coefficient above the L edge by 14%. These revised data lead to a total oscillator strength consistent with the known electron density and are in agreement with dc-conductivity and stopping-power measurements as well as with absorption coefficients inferred from the cross sections of neighboring elements in the periodic table. The optical functions resulting from this study show evidence for both the redistribution of oscillator strength between energy levels and the effects on real transitions of the shielding of conduction electrons by virtual processes in the core states.

35166 **Aluminum nitride films by rf reactive ion-plating.** Murayama, Y.; Kashiwagi, K.; Kikuchi, M. (Department of Electrical Engineering, Toyo University, Kawagoe, Saitama 350, Japan). *J. Vac. Sci. Technol.;* **17**: No. 4, 796-799(Jul 1980).

Aluminum nitride films were synthesized successfully on silicon (111) and spinel (111) single crystal surfaces by rf reactive ion-plating. Aluminum was evaporated from an evaporator in the rf discharge phase of either nitrogen gas or ammonia gas at a pressure of 10^{-4} Torr ($\sim 10^{-2}$ Pa). Film structures were evaluated using reflection high energy electron diffraction (RHEED) and scanning electron microscopy (SEM). The aluminum nitride films synthesized on the spinel (111) surfaces at the substrate temperature of 1000 °C, in the rf discharge phase of both nitrogen gas and ammonia gas, were found to be of single crystal form, having parallel orientation to the substrate surfaces. Aluminum nitride single crystals forming hexagonal pyramids were observed to grow in the perpendicular direction to the substrate surfaces during the study. The growth rate of aluminum nitride film obtained in the ammonia gas discharge, which was about 500 A min^{-1}, was about two times as fast as that obtained in the nitrogen gas discharge.

35167 **Very high temperature thermophysical properties of solid and liquid vanadium and iridium.** Gathers, G.R.; Shaner, J.W.; Hixson, R.S.; Young, D.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *High Temp. - High Pressures;* **11**: No. 6, 653-668(1979).

Isobars of enthalpy, volume, temperature, and resistivity of vanadium and iridium have been measured up to 7000 K at 0.3 GPa by the isobaric expansion technique. The average values of csub(p)/R in the liquid phase are 7.9 for vanadium and 5.7 for iridium. Agreement between present experiments and previous work is good. The liquid volume and enthalpy data have been fitted with the semiempirical soft-sphere theory and the critical parameters have been estimated.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 34471, 34481, 34903, 34906, 35148, 35285, 35373

35168 (AD-A—078596/4) **Passive films, surface structure and stress corrosion and crevice corrosion susceptibility. Annual report Nov 77-Nov 78.** Kruger, J.; Carroll, J.J.; Melmed, A.J.; Ritter, J.J.; Ambrose, J.R. (National Bureau of Standards, Washington, DC (USA)). Nov 1978. 37p. NTIS, PC AA03/MF A01.

Field ion microscopy (FIM) is capable of imaging defects such as sub-critical crack formation and growth, and surface rearrangements, and of detecting new surface phase formations, and other disturbances. The technique was used to characterize various modes of hydrogen reactions with metal surfaces. Previous work has revealed examples of one mode, the initial crack formation and growth in the hydrogen-titanium and hydrogen-zirconium systems. In each case there were indications of preferential crystallographic attack producing cracks within the metal matrix approximately 10-15 atomic layers deep in the case of titanium, and 2-5 layers deep in the case of zirconium. In the present phase of the work, FIM was used to examine microscopic details of the initial stages of hydrogen interactions with some additional pure metals and metal alloys, i.e., niobium, aluminum, 304 stainless steel and iron-24 wt. and chronium steel. The hydrogen-metal interactions occurred during the FIM imaging process with hydrogen pressures between ten to the minus 4th power and ten to the minus 6th power torr at metal temperatures between 20 and 80 K, and while the metal was subjected to stresses brought about by the electric field necessary for imaging the multifacted, approximately hemispherical metal surface. The method used involved comparison of micrographs obtained during inert gas imaging (neon, helium) with micrographs obtained in pure hydrogen or mixtures of hydrogen and inert gases.

35169 (AD-A—078812/5) **Hydrogen entry and transport mechanisms in structural metals. Final technical report.** Heidersbach, R.; Surkein, M.; Allen, B.; Jones, J. (Rhode Island Univ., Kingston (USA). Dept. of Ocean Engineering). Nov 1979. 42p. NTIS, PC AA03/MF A01.

This report summarizes the results of an investigation into the optimization of the electrochemical hydrogen permeation technique. The results of the research can be summarized as follows: 1. Hydrogen permeation fluxes through iron membranes have been demonstrated to be affected by the reactivity of the membrane surfaces. The use of electroplated palladium entry and exit surfaces is recommended if the object of the study is to measure hydrogen mass transfer rates through a ferrous, or similar metal, membrane. 2. The apparent hydrogen diffusivity rates determined in this research are slower than those commonly reported in the literature. 3. Diffusivities based on times to reach steady-state could not be calculated for electrochemically-charged membranes because steady-state fluxes were never reached during the one-week duration of the permeation experiments. 4. An attempted determination of the effects of electroslag remelting on the hydrogen permeability of high strength steels could measure no significant difference between the steels tested.

35170 (UCID—18593) **Laboratory procedures used in the hot corrosion project.** Jeys, T.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Apr 1980. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01.

The objective of the Hot Corrosion Project in the LLNL Metals and Ceramics Division is to study the physical and chemical mechanisms of corrosion of nickel, iron, and some of their alloys when these metals are subjected to oxidizing or sulfidizing environments at temperatures between 850 and 950°C. To obtain meaningful data in this study, we must rigidly control many parameters. Parameters are discussed and the methods chosen to control them in this laboratory. Some of the mechanics and manipulative procedures that are specifically related to data access and repeatability are covered. The method of recording and processing the data from each experiment using an LS-11 minicomputer are described. The analytical procedures used to evaluate the specimens after the corrosion tests are enumerated and discussed.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 34913, 34931, 35830, 35831, 35834

35171 (DOE/ER/03158—91) **Direct observations of the primary state of radiation damage of ion-irradiated tungsten and platinum.** Seidman, D.N.; Current, M.I.; Pramanik, D.; Wei, C.Y. (Cornell Univ., Ithaca, NY (USA)). Jul 1980. Contract AS02-76ER03158. 9p. (CONF-800744—6). NTIS, PC A02/MF A01.

From Ion beam modification of materials conference; Albany, NY, USA (14 Jul 1980).

A brief summary was presented of all the Cornell work on the primary state of radiation damage in ion-irradiated tungsten and platinum. The primary research tool for all this research was the field-ion microscope (FIM); the FIM was ideally suited for this research because of its excellent atomic resolution and the ability to examine the interior of the specimens, as a result of the field-evaporation effect. This paper summarized, in outline form, the following items: (1) the principal experimental quantities determined from the analyses performed on all the individual depleted zones (DZs) observed; (2) the main experimental programs; (3) a number of the more important results and conclusions concerning the vacancy structure of DZs; and (4) the three-dimensional spatial distribution of self-interstitial atoms around DZs in tungsten which had been irradiated and examined in situ at 10°K.

35172 (ORNL/TM—7470) **ORNL irradiation creep facility.** Reiley, T.C.; Auble, R.L.; Beckers, R.M.; Bloom, E.E.; Duncan, M.G.; Saltmarsh, M.J.; Shannon, R.H. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 54p. NTIS, PC A04/MF A01.

A machine was developed at ORNL to measure the rates of elongation observed under irradiation in stressed materials. The source of radiation is a beam of 60 MeV alpha particles from the Oak Ridge Isochronous Cyclotron (ORIC). This choice allows experiments to be performed which simulate the effects of fast neutrons. A brief review of irradiation creep and experimental constraints associated with each measurement technique is given. Factors are presented which lead to the experimental choices made for the Irradiation Creep Facility (ICF). The ICF consists of a helium-filled chamber which houses a high-precision mechanical testing device. The specimen to be tested must be thermally stabilized with respect to the temperature fluctuations imposed by the particle beam which passes through the specimen. Electrical resistance of the specimen is the

temperature control parameter chosen. Very high precision in length measurement and temperature control are required to detect the small elongation rates relevant to irradiation creep in the test periods available (~ 1 day). The apparatus components and features required for the above are presented in some detail, along with the experimental procedures. The damage processes associated with light ions are discussed and displacement rates are calculated. Recent irradiation creep results are given, demonstrating the suitability of the apparatus for high resolution experiments. Also discussed is the suitability of the ICF for making high precision thermal creep measurements.

35173 Precipitation response of 20%-cold-worked type 316 stainless steel to simulated fusion irradiation. Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **85**: No. 86, 713-717(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

The precipitation response of 20%-cold-worked type 316 stainless steel has been examined after irradiation in HFIR at 380-600°C, after irradiation in EBR-II at 500°C, and after thermal aging at 600 to 750°C. Eta phase forms during exposure to all environments. It constitutes a major portion of the precipitation response, and is rich in Ni, Si and Mo relative to $M_{23}C_6$ after thermal aging. It is not normally reported in 20%-cold-worked type 316 stainless steel. The eta, $M_{23}C_6$, Laves, sigma, and chi precipitate phases appear at similar temperatures after HFIR, EBR-II, or thermal exposure. There are, however, some differences in relative amounts, size, and distribution of phases among the various environments. Eta phase is the only carbide-type phase observed after irradiation in HFIR from 380-550°C. The large cavities associated with it at 380°C contribute significantly to swelling. Re-solution of fine $M_{23}C_6$, eta, and Laves particles and re-precipitation of massive particles of sigma, $M_{23}C_6$ and chi are observed after recrystallization in HFIR.

CERAMICS, CERMETS, AND REFRACTORIES

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 35062

35174 (LBL—11124) **Gas-solid interface reaction.** Chang, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering). Jul 1980. Contract W-7405-ENG-48. 66p. NTIS, PC A04/MF A01.

Thesis.

The reduction kinetics of dense $CoFe_2O_4$ by pure hydrogen were studied thermogravimetrically in the temperature range of 560°C to 620°C, and in the pressure range of 50 torr to 250 torr. Under these experimental conditions, a porous topochemical metal product layer formed, with a simple oxide/metal interface. The reduction reaction was found to be under mixed control. The contribution of the gas diffusion resistance and of the interface reaction resistance were determined using a mathematical model based on one derived by Spitzer, Manning, and Philbrook. It was found that the effective gas diffusion coefficient depended weakly on temperature, while the interface reaction followed Langmuir-Hinshelwood kinetics.

35175 Swelling and gas release in ZnO. Solomon, A.A.; Hsu, F. (Purdue Univ., West Lafayette, IN). *J. Am. Ceram. Soc.;* **63**: No. 7-8, 467-474(Jul 1980).

Swelling and gas release in a model ceramic system, ZnO, were studied under known internal and external pressures, oxygen partial pressures, and temperatures. When gas was not released, the instantaneous swelling strain rate was: epsilon varies as (DF exp-Q/RT) where DF is the instantaneous pressure driving force for swelling, Q = 141+-13 kcal/mol, and RT has its usual meaning. For a fixed initial driving force for swelling, the strain rate decreased as t/sup-1/3/ where t is time. Volumetric swelling strains of ≧ 11% were measured prior to gas release, indicating that swelling is not simply reversed sintering. Gas release was usually observed and occurred by the interconnection of intergranular porosity. A resintering process immediately followed gas release, but at a slower rate than the initial sintering rate at the same density. Analysis of the swelling experiments yielded a surface energy of ≈ 0.3 J/m² at 920°C for ZnO.

35176 Surface segregation of alumimum (spinel precipitation) in MgO crystals. Kingery, W.D. (Massachusetts Inst. of Tech., Cambridge); Robbins, W.L.; Henriksen, A.F.; Johnson, C.E. *J. Am. Ceram. Soc.;* **58**: No. 5-6, 239-241(May 1976).

MgO single crystals containing 0.006 and 0.187 wt% Al in solid solution at 1850°C were quenched and slow cooled. Analysis of the Al distribution near the surface with ion microprobe mass analysis indicated an increased Al concentration and near-surface precipitation within a region 1/2 to 4 μm thick in the slow-cooled samples and a much smaller enhanced concentration in the region 0.1 to 0.2 μm from the surface in the quenched samples.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 35176, 35180

35177 (CONF-800908—2) **Czochralski growth of single-crystal gehlenite ($Ca_2Al_2SiO_7$).** Finch, C.B.; Ball, F.L.; Bates, J.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01.

From 6. international conference on crystal growth; Moscow, USSR (Sep 1980).

Single-crystal boules of gehlenite ($Ca_2Al_2SiO_7$) were grown from even- and off-stoichiometry melts under differing conditions of oxygen fugacity (F_{O2}). Growth was accomplished by the Czochralski method at 1600°C and 10^5 Pa (1 atm) total pressure, using inductively heated Ir or Pt-20% Rh crucibles. The supra melt gas ambients included air (f_{O2} = 0.2 x 10^4 Pa), Ar (10 Pa), Ar-50% CO_2-2% H_2 (10^{-2} Pa), and Ar-4% H_2-1.5% H_2O (10^{-4} Pa). Colorless, transparent material up to 8 mm diam by 15 mm long was obtained from the evenly stoichiometric melt composition under Ar at growth rates of 1.5 mm/h or less. Growth at rates exceeding 2 mm/h or growth at a high f_{O2} (e.g., air), led to the formation of bubbles and elongated voids or inclusions, predominantly in the core regions of boules. Optical, x-ray diffraction, and electron-induced x-ray fluorescence data are included.

35178 (CONF-800928—6) **Initial epitaxy of (111)Pt on (111)Au.** Knabbe, E.A.; Chao, S.S.; Vook, R.W. (Syracuse Univ., NY (USA)). 1980. Contract AS02-77ER04496. 5p. NTIS, PC A02/MF A01.

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

Thin Pt films were formed epitaxially in UHV at 25°C on thick (111) Au films previously deposited in situ on (111) NaCl films formed on mica. The Pt/Au bilayers were characterized by TEM, TED and RHEED. The thicknesses of the Pt overgrowths ranged from 0.8 A to 27 A. Long straight misfit dislocations extended completely across the interface only above 9 A. TED and RHEED indicated pseudomorphism up to 8 A of Pt, where separate TED reflections were first detected. Interdiffusion phenomena during TEM examination were readily detected as a decrease in the misfit dislocation density during observation. The mode of Pt growth appears to be one of flat islands with complete continuity occurring at an average thickness of 4 monolayers or less.

35179 Interaction of molten silicon with silicon aluminum oxynitrides. Wills, R.R.; Sekercioglu, I.; Niesz, D.E. (Battelle Columbus Laboratories, OH). Contract DOE/JPL-954876. *J. Am. Ceram. Soc.;* **63**: No. 7-8, 401-403(Jul 1980).

Silicon aluminum oxynitride solid solutions (sialons) based on β-Si_3N_4 and Si_2N_2O behave differently in contact with molten silicon. The Si_2N_2O-based sialons convert to almost pure Si_3N_4, apparently through a two-step decomposition and solution-precipitation reaction, whereas, the β-Si_3N_4 sialons are preferentially attacked at the grain boundaries. The composition of the grain-boundary phase appears to control the rate of reaction.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 34471, 35175

35180 (DOE/OR/20679—T1) **High temperature applications of structural ceramics. Quarterly progress report, January—March 1980.** Schneider, S.J. (National Bureau of Standards, Washington, DC (USA). Center for Materials Science). 1980. Contract AI05-800R20679. 14p. NTIS, PC A02/MF A01.

Four-point bend tests on notched bars of Si_6AlON_7 were completed and the results compared with previous work on a yttria-doped silicon nitride (NCX 34) and with literature values for other silicon nitrides. Preliminary maps for Si_3N_4 have been drawn. A computer program for automatically drawing maps from K-v data has been written. Data for SiC has been collected. A new mechanical analysis of 4-point bending has been completed to get K-v data from load-deflection curves. Experiments with heating Si_3N_4 in $95N_2$:$5H_2$ at ~ 1750°C in various container materials indicated that Mo was a suitable container for short term heat treatments. High temperature x-ray diffraction experiments were initiated with mixed α-β Si_3N_4 specimens. Comparison by x-ray powder diffraction of two billets of Si_3N_4 containing approximately 8 wt % Y_2O_3 failed to show any difference in the phase analysis that could account for the observed difference in low-temperature oxidation resistance. The two billets contained nearly equal amounts of WSi_2 before oxidation, but this compound could not be detected in a specimen that had been severely damaged by oxidation for 20 hours at 735°C.

35181 (GEPP-TIS—503) **Axial compression testing of vacuum tube glass-ceramic/molybdenum frames.** Spears, R.K. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 17 Sep 1980. Contract AC04-76DP00656. 34p. NTIS, PC A03/MF A01.

The strength of a vacuum tube subassembly is affected by many factors, including the subassembly design, the process used to bond the parts, and the type of equipment used to measure the strength. In this study, these variables were examined for a subassembly consisting of a molybdenum sleeve, a glass-ceramic insulator, and a molybdenum cylindrical frame. Results showed that compression testing of different designs ranged from 765 to 3170 pounds. No difference appeared in the strength of subassemblies due to variations in selected steps in processing. A self-aligning compression test fixture resulted in higher strength readings than those obtained with conventional fixturing.

35182 **Suppression of cavity formation in ceramics: prospects for superplasticity.** Evans, A.G. (Univ. of California at Berkeley); Rice, J.R.; Hirth, J.P. Contract W-7405-ENG-48. *J. Am. Ceram. Soc.;* **63**: No. 7-8, 368-375(Jul 1980).

Ceramics exhibit macroscopic stress/strain rate relations that should lead to superplastic extension. However, premature fracture is normally encountered, due to the formation and growth of grain-boundary cavities. Thus, cavity nucleation and growth were analyzed in an attempt to identify microstructures and/or strain-rate regimes that would suppress cavity evolution and hence allow superplasticity. Analysis of cavity nucleation indicates that fine-grained materials devoid of grain-boundary amorphous phases and inclusions should sustain substantial deformation rates without nucleating cavities, especially if solid-solution additions that encourage rapid grain-boundary diffusion (while not excessively decreasing surface energy) are identified. The analysis of void growth indicates that high relative surface diffusivities are also desirable, indicating that alloy additions that do not depress (and probably enhance) the relative surface diffusivities must be selected.

35183 **Electrochemical degradation of ceramic electrodes.** Mizusaki, J.; Cannon, W.R.; Bowen, H.K. (Massachusetts Inst. of Tech., Cambridge). Contract EF-76-C-01-2215. *J. Am. Ceram. Soc.;* **63**: No. 7-8, 391-397(Jul 1980).

Calculations of oxygen chemical potentials in the interior of ceramic electrodes with ion blocking interfaces indicate that phase changes and/or decomposition will occur as a result of dc polarization. For electrodes with reversible interfaces, unacceptably thick oxidation layers can form. Results are applied to nonslag and slag-covered MHD electrodes.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 35175, 35178

35184 (AD-A—078540/2) **Thermal conductivity and diffusivity of engineering ceramics. Final technical report 15 Sep 78-14 Sep 79.** Youngblood, G.E.; Bentsen, L.D. (California Univ., Los Angeles (USA). School of Architecture and Urban Planning). 15 Nov 1979. Contract N00014-78-C-0726. 139p. NTIS, PC AA07/MF A01.

This report summarizes the results of a one-year research program devoted to an investigation of the effect of compositional and microstructural variables on the thermal conductivity/diffusivity of engineering ceramics. Particular emphasis was placed on studies of thermal transport phenomena in composite materials. A total of six completed studies have resulted during this program, with another four in progress, as follows: (1) Effect of Crystallization on the Thermal Diffusivity of a Cordierite Glass-Ceramic. (2) Thermal Diffusivity of Ba/Mica/Alumina Composites. (3) Thermal Diffusivity of Al2O3 with Dispersed Monoclinic and Tetragonal ZrO2 particles. (4) Effect of thermal Expansion Mismatch on the Thermal Diffusivity of Glass-Ni Composites. (5) Simple Laser Pulse Calorimeter. (6) Thermal Diffusivity/Conductivity of Dense Magnesia/Magnesia-Alumina Spinel Ceramic. (7) Thermal Diffusivity of Al2O3/SiC Composites. (8) Thermal Diffusivity of MgO/SiC Composites. (9) Thermal Diffusivity of Al2O3/TiC Composites. (10) Thermal Diffusivity of a Partially Electronic Conducting Ceramic: Yttrium Chromites. (Author)

35185 (ENICO—1048) **Characterization of vitrified ICPP alumina waste calcine.** Cole, H.S.; Brotzman, J.R.; Simpson, G.G. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Aug 1980. Contract AC07-79ID01675. 24p. NTIS, PC A02/MF A01.

The properties of one borosilicate and two borophosphate glasses previously developed to vitrify an ICPP alumina nuclear waste calcine are determined. Based on melt viscosity at 1100°C and leach rate, the maximum permissible calcine contents in the borophosphate and borosilicate formulations are 26 and 16 mol%, respectively. Glasses containing lesser amounts of calcine do not develop crystalline compounds upon annealing. Based upon the same viscosity and leach rate criteria, 40 wt % CaO or zirconia calcine can be substituted for alumina calcine in the borophosphate glasses. Ten wt % of either additive can be substituted for alumina calcine in the borosilicate glass. Minor modifications of the alkali or cupric oxide content in the borophosphate glasses does not alter glass characteristics.

35186 **Variations of strain and light scattering accompanying domain switching in lead lanthanum zirconate titanate ceramics.** Chen, P.J.; Land, C.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *J. Appl. Phys.;* **51**: No. 9, 4961-4966(Sep 1980).

Experimental results relating mechanical strain and visible-light scattering to ferroelectric domain switching as the electric displacement of lead lanthanum zirconate titanate (PLZT) 7/65/35 is switched through the hysteresis loop are presented. Both strain and light scattering measurements were made before and after storing a photoinduced space-charge field E/sub SC/ in first a radially constrained and then an unconstrained PLZT disc. The results of these measurements tend to clarify the role of E/sub SC/ in photoferroelectric information storage. Specifically, E/sub SC/ is nonvolatile and cannot be reoriented by an externally applied switching field alone. The thresholds for domain switching in the bulk of the PLZT are lowered in the direction of E/sub SC/, but they are increased to the extent of preventing some domain switching antiparallel to E/sub SC/.

35187 **Ultraviolet photoemission studies of the bonding of CO to the ZnO (1010) surface and its interaction with atomic hydrogen.** D'Amico, K.L.; McClellan, M.R.; Sayers, M.J.; Gay, R.R.; McFeely, F.R.; Solomon, E.I. (Department of Chemistry and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). DE-A502-78ER04998. *J. Vac. Sci. Technol.;* **17**: No. 5, 1080-1084(Sep 1980).

Angle integrated and angle resolved He II photoemission spectroscopy have been used to characterize the adsorption of carbon monoxide and hydrogen on the ZnO (1010) surface, and to study their interaction. Hydrogen chemisorption is consistent with the formation of H^+ (as $(OH)^-$) and H^- (as $(ZnH)^+$) at high coverages due to the requirement of surface charge compensation. The primary interaction between the surface hydrogen and adsorbed CO is found to be site competition.

35188 **Jahn-Teller resonance states in the Vb metal hydrides: A model calculation.** Abell, G.C. (Monsanto Research Corporation, Mound Facility, Miamisburg, Ohio 45342). DE-AC04-76-DP00053. *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 2014-2019(15 Aug 1980).

A simple tight-binding model representing hydrogen in the Vb metals and including a special electron-phonon interaction is shown to give a molecular Jahn-Teller resonance state for physically reasonable values of the various energy parameters. This unusual resonance state is pinned to the shell of metal atoms adjacent to hydrogen by an effective Coulombic attraction that exists because of the nearly equal but opposite electron displacements on that shell, caused by the direct interaction of hydrogen on the one hand and by the Jahn-Teller interaction on the other. The mutual orthogonality of these two interactions implies that the Jahn-Teller state is an intrinsic feature of the host metal.

35189 **Mixed-alkali effect in the dilute foreign-alkali region. Failure of the strong electrolyte/cationic interaction model.** Moynihan, C.T.; Saad, N.S.; Tran, D.C.; Lesikar, A.V. (Catholic Univ. of America, Washington, DC). *J. Am. Ceram. Soc.;* **63**: No. 7-8, 458-464(Jul 1980).

Electrical conductivity and relaxation data were measured for glasses of composition $0.242[XK_2O+(1-X)Na_2O]$ - $0.758SiO_2$ from 25° to 205°C and in the dilute Na+ ion composition range X = 0.9 to 1. The decrease in electrical conductivity σ when the majority alkali K+ is replaced with the foreign alkali Na+ is most rapid in the very dilute range X = 0.98 to 1 and becomes less rapid at larger Na+ contents. The electric field relaxation times agree well with the single-alkali mechanical relaxation times. The electric field relaxation function becomes more exponential with increasing foreign alkali content, indicating a corresponding decrease in the concentration of mobile ions. Attempts to account for the decrease in σ with increasing foreign alkali content by assuming that the single-alkali glass is a strong electrolyte and that the foreign alkali complexes with and immobilizes the majority alkali were unsuccessful. Calculated values of the number of majority alkali ions complexed by a foreign-alkali ion were unreasonably large.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 34906, 34910

35190 **Oxidation of CVD Si_3N_4 at 1550° to 1650°C.** Hirai, T.; Niihara, K.; Goto, T. (Tohoku Univ., Sendai, Japan). *J. Am. Ceram. Soc.;* **63**: No. 7-8, 419-424(Jul 1980).

A thermogravimetric study of the oxidation behavior of chemically vapor-deposited amorphous and crystalline Si_3N_4 (CVD

Si_3N_4) was made in dry oxygen (0.1 MPa) at 1550° to 1650°C. The specimens were prepared under various deposition conditions using a mixture of $SiCl_4$, NH_3, and H_2 gases. The crystalline CVD Si_3N_4 indicated a parabolic oxidation kinetics over the whole temperature range, whereas the amorphous CVD Si_3N_4 changed from a parabolic to a linear law with increased temperature. The oxidation mechanism is discussed in terms of the activation energy for the oxidation and the microstructure of the formed oxide films.

35191 Method for preparing corrosion-resistant ceramic shapes. Arons, R.M.; Dusek, J.T. US Patent Application 101,363. 7 Dec 1979. 14p.

Ceramic shapes having impermeable tungsten coatings can be used for containing highly corrosive molten alloys and salts. The shapes are prepared by coating damp green ceramic shapes containing a small amount of yttria with a tungsten coating slip which has been adjusted to match the shrinkage rate of the green ceramic and which will fire to a theoretical density of at least 80% to provide an impermeable coating.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 34931, 35832

35192 Effect of irradiation temperature on the growth of helium bubbles in boron carbide. Hollenberg, G.W.; Mastel, B.; Basmajian, J.A. (Westinghouse Hanford, Co., Richland, WA). Contract EY-76-C-14-2170. *J. Am. Ceram. Soc.;* **63**: No. 7-8, 376-380(Jul 1980).

Boron carbide, in nuclear reactor neutron absorber applications, generates large quantities of helium, some of which is trapped in small bubbles within the grains. Transmission electron microscopy was used to examine the size distribution, shape, and density of these bubbles in boron carbide irradiated, at 540° to 1850°C, to burnups of 62 x 10^{20} captures/cm^3. Bubble density was reduced but bubble diameter was increased at high temperatures. Bubbles were flat disks at low temperatures and more equiaxed at higher temperatures.

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

35193 (UCID—18765) **Continuous mixing and application for wet winding fiber composites.** Sanchez, R.J.; Sherry, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Aug 1980. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01.

A method is described for mixing and applying matrix during fiber composite winding. The method allows precise control of the fiber-matrix ratio and easy adjustment of the ratio at any time.

35194 Preparation and uses of amorphous boron carbide coated substrates. Riley, R.E.; Newkirk, L.R.; Valencia, F.A.; Wallace, T.C. US Patent Application 100,754. 5 Dec 1979. 21p.

Cloth is coated at a temperature below about 1000°C with amorphous boron-carbon deposits in a process which provides a substantially uniform coating on all the filaments making up each yarn fiber bundle of the cloth. The coated cloths can be used in the as-deposited condition for example as wear surfaces where high hardness values are needed; or multiple layers of coated cloths can be hot-pressed to form billets useful for example in fusion reactor wall armor. Also provided is a method of controlling the atom ratio of B:C of boron-carbon deposits onto any of a variety of substrates, including cloths.

STRUCTURE AND PHASE STUDIES

35195 (SAND—80-1914c) **Morphology and phase composition of an amine cured rubber modified epoxy.** Sayre, J.A.; Assink, R.A.; Lagasse, R.R. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 31p. (CONF-800844—1). NTIS, PC A03/MF A01.

From International conference on polymer compatability and incompatability - prinicples and practices; Midland, MI, USA (18 Aug 1980).

The sharpness of the interface between the matrix and the dispersed phase, the volume fraction of the dispersed phase, the distribution of particle sizes, and the concentration of epoxy in the dispersed phase were determined. Scanning transmission electron microscopy coupled with energy dispersive x-ray analysis revealed that the interface width is less than 500 A. Variation of the fraction of mobile hydrogens with temperature determined by nuclear magnetic resonance indicated that a small fraction of segments participated in mixing at the interface. Differential scanning calorimetry and nuclear magnetic resonance indicated that all the rubber precipitates as a discrete phase. The distribution of particles greater than 0.1 μm in diameter was measured, and the average diameter of these particles was found to be 0.8 μm. The particles larger than 0.1 μm accounted for approximately 50% of the total volume of dispersed phase. The epoxy concentration in the dispersed phase was determined using ^{13}C nuclear magnetic resonance spectroscopy. This concentration was found to be less than that predicted if all the epoxy monomer units attached to the rubber molecules were present in the dispersed phase.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 35194

35196 (CONF-800969—1) **Testing program for determining the mechanical properties of concrete to temperatures of 621°C.** Oland, C.B.; Naus, D.J.; Robinson, G.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01.

From American Concrete Institute fall convention; San Juan, Puerto Rico (24 Sep 1980).

Concrete temperatures in a Liquid Metal Fast Breeder Reactor (LMFBR) in excess of normal code limits can result from postulated large sodium spills in equipment cells. Elevated temperature concrete property data which may have application for providing a basis for the design and evaluation of such postulated accident conditions is limited. Data thus needed to be developed commensurate with LMFBR plant applications for critical physical and mechanical concrete properties under prototypic thermal accident conditions. A test program was conducted to define the variations in physical and mechanical properties of a limestone aggregate concrete and a lightweight insulating concrete exposed to elevated temperatures. Five test series were conducted: unconfined compression, shear, rebar bond, sustained loading (creep), and thermal properties. Testing procedures for determining the mechanical properties of concrete from ambient to 621°C (1150°F) are described. Ther thermal properties tests are discussed in a separate paper which is also being presented at this conference.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

35197 (BDX—613-2476) **Laser cutting plastic materials.** Van Cleave, R.A. (Bendix Corp., Kansas City, MO (USA)). Aug 1980. Contract AC04-76DP00613. 42p. NTIS, PC A03/MF A01.

A 1000-watt CO_2 laser has been demonstrated as a reliable production machine tool for cutting of plastics, high strength reinforced composites, and other nonmetals. More than 40 different plastics have been laser cut, and the results are tabulated. Applications for laser cutting described include fiberglass-reinforced laminates, Kevlar/epoxy composites, fiberglass-reinforced phenolics, nylon/epoxy laminates, ceramics, and disposable tooling made from acrylic.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 35362

35198 (BMFT-FB-T—80-036) **Space-charges in polymers.** Andress, B.; Fischer, P.; Nissen, K.; Roehl, P. (Siemens A.G., Erlangen (Germany, F.R.). Forschungslaboratorium). Aug 1980. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01.

A nondestructive method for the determination of space-charges in polyethylene has been developed. It was shown by direct measurement that electrons are injected into the polyethylene. No difference in the space-charge build up is observed when different contacting metals or semiconducting polymer electrodes are used. During ac-stressing space-charges build up very gradually in the polymer, but an influence upon the breakdown strength was not registered even after prestressing for long times at high average field strengths. It seems more probable that physical/chemical changes account for the observed decrease in breakdown strength with time. Further breakdown measurements indicate that breakdown in polyethylene is initiated in the crystalline regions by electronic processes. It was possible to correlate the improved breakdown strength of oxidized polyethylenes with the electrical conduction behavior in these materials. During this latter work the understanding of the conduction process was considerably advanced through inclusion of a hopping-time distribution for the electronic carrier transport.

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 34635, 34636, 34638, 34639, 34642, 34648, 34649, 34650

STRUCTURE AND PHASE STUDIES

35199 (GEPP-TIS—516) **Microstructure examination of the interface of the glass-ceramic insulator of the molybdenum frame of a vacuum tube.** Spears, R.K. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 17 Sep 1980. Contract AC04-76DP00656. 12p. NTIS, PC A02/MF A01.

A common technique used in examining the structural integrity of a glass-ceramic insulator-molybdenum cylinder bond in a vacuum tube subassembly is to slit the outer molybdenum cylinder and separate it from the glass-ceramic insulator. Typically, a black glassy layer (0.001 to 0.002 in. thick) remains on the cylinder. This layer has been interpreted as a requirement for an adequate seal. A subassembly was found that did not exhibit this feature. Further investigation of approximately 100 subassemblies revealed four more parts lacking a black glassy layer. These parts were found to be from two production runs and from three glass-ceramic lots. A microstructural analysis showed that on those parts having a black glassy layer, the crystalline phase in the glass-ceramic grew to within one to two microns of the metal interface and then terminated. A dark region existed in the insulator between the interface and the termination of the crystalline phase. This was attributed to molybdenum oxide dissolved in the glass. On those parts where the glass-ceramic broke clean from the cylinder, the crystalline phase extended up to the metal. Also observed on these parts was the appearance of a dark region adjacent to the metal that extended approximately one to two microns into the glass-ceramic. This was assumed to be an oxide of molybdenum. This report presents information concerning the microstructure of the interface.

PROPERTIES

REFER ALSO TO CITATION(S) 35214, 35775, 35781, 35782

35200 **Ground state properties and energy parameters of the Anderson lattice system, $CeAl_2$.** Parks, R.D.; Kupferberg, L.C. (Rochester Univ., NY) (USA)); Croft, M.C. (Rutgers--the State Univ., Piscataway, NJ (USA)); Shapiro, S.M.; Gurewitz, E. (Brookhaven National Lab., Upton, NY). *J. Phys. (Paris), Colloq.;* No. 5, C5.323-C5.325(1979).

From International colloquium on physics of metallic rare earths; Saint-Pierre-de-Chartreuse, France (4 - 7 Sep 1978).

Magnetostriction and thermal expansion measurements on $CeAl_2$ in and near the antiferromagnetic (AF) phase have established (1) the AF phase boundary in the H-T plane; (2) the nature of the reorientation of the AF domains in field, the evolution of the AF order parameter in field and the nature of the AF fluctuations above Tsub(N); and (3) that the magnetic exchange between Ce atoms is ferromagnetic in large fields. Inelastic neutron scattering measurements reveal a new and yet unexplained feature at 17.5 meV.

35201 **Hall measurements and grain-size effects in polycrystalline silicon.** Ghosh, A.K.; Rose, A.; Maruska, H.P.; Eustace, D.J.; Feng, T. (Exxon Research and Engineering Company, Linden, New Jersey 07036). XJ-0-9077-1. *Appl. Phys. Lett.;* **37**: No. 6, 544-546(15 Sep 1980).

The effects of grain size on Hall measurements in polycrystalline silicon are analyzed and interpreted, with some modifications, using the model proposed by Bube. This modified model predicts that the measured effective Hall voltage is composed of components originating from the bulk and space-charge regions. For materials with large grain sizes, the carrier concentration is independent of the intergrain boundary barrier, whereas the mobility is dependent on it. However, for small grains, both the carrier density and mobility depend on the barrier. These predictions are consistent with experimental results of mm-size Wacker and μm-size neutron-transmutation-doped polycrystalline silicon.

35202 **Further experimentation on Taylor instability in solids.** Barnes, J.F.; Janney, D.H.; London, R.K.; Meyer, K.A.; Sharp, D.H. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). W-7405-ENG.36. *J. Appl. Phys.;* **51**: No. 9, 4678-4679(Sep 1980).

Recently Drucker has provided an alternative theoretical analysis of the Rayleigh-Taylor experiments on flat metal plates that we reported on earlier. His analysis is at variance with our conjecture in that it explains the small growth observed in one of our experiments on an initial amplitude, rather than an initial wavelength, basis. In this note we report the results of an experiment designed to test these two competing explanations; Drucker's conclusions appear to be confirmed.

35203 **ZnTe extrinsic photodetector for visible integrated optics.** Hamdi, H.; Valette, S. (LETI: Commissariat a l'Energie Atomique: 85X 38041 Grenoble, France). *J. Appl. Phys.;* **51**: No. 9, 4739-4741(Sep 1980).

Oxygen implantation in ZnTe may be used to obtain optical absorption at wavelengths higher than 0.55 μm, which is the normal absorption edge in this compound semiconductor. Optical waveguides obtained by boron implantation in this material are associated with detectors using that extrinsic absorption effect in the presence of a Schottky barrier depletion layer. The responsivity of the photodetector is about 5×10^{-2} A/W at 0.61 μm and the rise time is less than 3 ns.

35204 **Column III and V elements on GaAs (110): Bonding and adatom-adatom interaction.** Skeath, P.; Su, C.Y.; Lindau, I.; Spicer, W.E. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). *J. Vac. Sci. Technol.;* **17**: No. 5, 874-879(Sep 1980).

Column V elements adsorbed on GaAs (110) exhibit strikingly different behavior than adsorbed column III elements in terms of the overlayers bonding to the semiconductor, the effect on the semiconductor surface lattice, and long-range order. A strong interaction between adatoms is found with submonolayer coverings of column III metals which leads to the formation of flat raftlike metallic patches. Unlike the column III metals, Sb adsorption produces large changes in the electronic states and atomic arrangement of the semiconductor surface lattice. An elementary view of the factors responsible for the different characteristics and effects of these overlayers on GaAs (110) is given, but its extension to other adatoms is shown to be limited. These results have strong relevance to current theoretical models of Al and Ga overlayers on GaAs (110), as well as to molecular beam epitaxy and Schottky barrier formation.

35205 **Measurement and modulation of atomic interdiffusion at Au—Al/GaAs(110) interfaces.** Brillson, L.J.; Margaritondo, G.; Stoffel, N.G.; Bauer, R.S.; Bachrach, R.Z.; Hansson, G. (Xerox Webster Research Center, 800 Phillips Road W-114, Webster, New York 14580). *J. Vac. Sci. Technol.;* **17**: No. 5, 880-885(Sep 1980).

Atomic layers of Al at Au-GaAs(110) interfaces have been used to measure the absolute motion of metal and semiconductor atoms at their intimate contact. This new technique reveals both Au indiffusion and nonstoichiometric outdiffusion during the initial stages of Schottky barrier formation. The Al "interlayers" at Au—GaAs interfaces also modulate the relative Ga to As diffusion into Au by over an order of magnitude. This new phenomenon at compound semiconductor—metal interfaces reveals a systematic relationship between the local atomic bonding and the extended chemical structure of the interface.

35206 **Schottky barrier behavior in polycrystal GaAs.** Cohen, M.J.; Paul, M.D.; Miller, D.L.; Waldrop, J.R.; Harris, J.S. Jr. (Rockwell International Electronics Research Center, Thousand Oaks, California 91360). XS-9-8032-1. *J. Vac. Sci. Technol.;* **17**: No. 5, 899-903(Sep 1980).

The results of a study of the effects of grain boundaries on the electronic properties of Schottky barriers formed in polycrystal GaAs are reported. The samples investigated were fabricated on n-type (Sn doped) GaAs grown by MBE on large grain polycrystal n^+-GaAs substrates. Al layers were deposited in situ in the MBE chamber immediately following the growth of the epilayers and 10 mil Schottky dots were subsequently isolated photolithographically. The diodes characterized fell into three categories: (i) diodes which were located entirely within a single grain and exhibited ideal, $n=1$ behavior, (ii) diodes which straddled a grain boundary but whose electrical characteristics were indistinguishable from the single crystal diodes, and (iii) diodes which straddled a grain boundary and whose forward current contained an excess leakage component. The data are explained in terms of a model in which the Fermi level is pinned by localized bandgap states due to dangling bonds at the grain boundary and the resulting band bending causes a double depletion region in the bulk material.

35207 **Oxygen adsorption on the GaAs(110) surface.** Su, C.Y.; Lindau, I.; Skeath, P.R.; Chye, P.W.; Spicer, W.E. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). *J. Vac. Sci. Technol.;* **17**: No. 5, 936-941(Sep 1980).

The adsorption of nonexcited molecular oxygen on cleaved GaAs(110) surfaces at room temperature has been studied using photoemission techniques. Detailed analysis of the oxygen-induced structure in the valence-band region revealed two different forms of adsorbed oxygen. Adsorption in the first form saturates at a very low coverage (~0.01 monolayer) and is probably associated with defect sites. Adsorption in the second form occurs at normal surface sites and produces measurable chemical shifts in Ga-3d and As-3d core levels. The nature of the second form of oxygen has been further investigated with core level studies of surfaces oxidized at room temperature and subsequently heated to a high temperature. Annealing to moderately high temperature (~370°C) causes transfer of oxygen from As—O bonds to form additional Ga—O bonds. Fast heating to high temperature (430°—450°C) leads to desorption of roughly half of the oxygen atoms and all of the chemically affected As atoms, while little change in the Ga-3d core level is observed. Several previously proposed oxidation models are compared based on the present data.

35208 Theory of deep substitutional sp^3-bonded impurity levels and core excitons at semiconductor interfaces. Hjalmarson, H.P.; Allen, R.E.; Buettner, H.; Dow, J.D. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). DE-AC02-76ER01198. *J. Vac. Sci. Technol.;* **17**: No. 5, 993-996(Sep 1980).

A theory of the major chemical trends in the binding energies of deep substitutional sp^3-bonded impurity levels and Frenkel core excitons at interfaces is presented and applied to a GaAs/AlAs (110) interface.

35209 Systematics on the electron states of silicon d-metal interfaces. Braicovich, L.; Abbati, I.; Miller, J.N.; Lindau, I.; Schwarz, S.; Skeath, P.R.; Su, C.Y.; Spicer, W.E. (Istituto di Fisica del Politecnico, Milano, Italy). *J. Vac. Sci. Technol.;* **17**: No. 5, 1005-1008(Sep 1980).

We discuss the trends in photoemission spectra from some silicon d-metal interfaces: Si (111)—Au, Si (111)—Ag, Si (111)—Ni, Si (111)—Pd, Si (111)—Pt. In particular, we discuss the correlation between the chemical processes taking place at the interface and those in the formation of bulk silicon d-metal compounds. Although a general correlation is found, some important differences are seen; in particular, no evidence of the formation of strictly stoichiometric silicides in the interface is found even for the cases in which well defined bulk silicides are known to be stable. We discuss also the role of the hybridization between d-electrons of the metal and (sp) electrons of silicon in the formation of intermixed interface phases. The considerations presented here can be useful as guidelines to interpret future results on other reactive silicon d-metal interfaces.

35210 Unified defect model and beyond. Spicer, W.E.; Lindau, I.; Skeath, P.; Su, C.Y. (Electrical Engineering Department, Stanford University, Stanford, California 94305). *J. Vac. Sci. Technol.;* **17**: No. 5, 1019-1027(Sep 1980).

The unified defect model has been successful in explaining a wide variety of phenomena as oxygen or a metal is added to the III—V surface. These phenomena cover a range from a small fraction of a monolayer of adatoms to practical III—V structures with very thick overlayers. The tenets of the unified defect model are outlined, and the experimental results leading to its formulation are briefly reviewed. InP levels 0.4 and 0.1 eV and GaAs levels 0.7 and 0.9 eV below the conduction-band minimum (CBM) are associated with either missing column III or V elements. In InP, it has been found possible by a number of workers to "switch" between the two defect levels by variations in surface processing, temperature, and/or selection of the deposited atom. The need to apply the proper concepts for surface and interface chemistry and metallurgy is recognized, and the danger of using solely bulk concepts is emphasized. The reason for this is examined for certain cases on an atomic level. The need for new fundamental attacks on interface interaction is shown. The importance of semiconductor—oxide chemical stability is also recognized and, drawing on a large body of work from several laboratories, it is suggested that there will be more difficulties with "native" oxides on GaAs than on InP. It is concluded that "scientific engineering" of interfaces to give optimum performance should be a goal and test of the fundamental work described here. Specific possibilities are discussed for Schottky barriers on III—V's.

35211 Electronic structure of the diamond (111) 1 x 1 surface: Valence-band structure, band bending, and band gap states. Pate, B.B.; Spicer, W.E.; Ohta, T.; Lindau, I. (Stanford Electronics Laboratories, Stanford University, Stanford, California 94305). *J. Vac. Sci. Technol.;* **17**: No. 5, 1087-1093(Sep 1980).

Photoemission, LEED, and AES measurements were made on the mechanically polished (111) surface of a type IIa diamond. No emission from filled states in the fundamental gap was found over the photon energy range 13.3 eV< or =hω< or =200 eV. This result, coupled with the sharp 1 x 1 LEED patterns which were obtained and the relative cleanliness (of elements which can be detected by AES) of the diamond (< or ≃1 at.% oxygen, <0.5 at.% Si) suggests hydrogen termination of the lattice. Photoelectric yield measurements demonstrate the photoelectric threshold to be at band gap energy radiation. Investigation of the photoemission electron distribution curves (EDC's) shows that, while the electron affinity at the surface is always positive, band bending is sufficient to result in an effective negative electron affinity under certain conditions. A variable surface dipole on the atomic scale, possibly due to the adsorption—desorption of a background gas, is reported. A study of the relative cross section of the upper (p-like) versus the lower (s-like) portion of the diamond valence band indicates comparable cross sections at a photon energy hω=160 eV.

35212 Electronic structure of zinc-blende—wurtzite interfaces: ZnS-ZnS (111-0001) and ZnSe-ZnSe (111-0001). Northrup, J.E.; Ihm, J.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 2060-2065(15 Aug 1980).

Self-consistent pseudopotential calculations are performed for two zinc-blende—wurtzite interfaces: ZnS-ZnS (111-0001) and ZnSe-ZnSe (111-0001). The role of a change in structural symmetry across the interface is examined. Localized states are found, but these states have energies which are inside the bulk continuum. The projected band structures for the wurtzite and zinc-blende forms of ZnS and ZnSe are calculated.

35213 Hydrogen-associated disorder modes in amorphous Si:H films. Carlos, W.E.; Taylor, P.C. (Naval Research Laboratory, Washington, D.C. 20375). DE-AI01-79ET23078. *Phys. Rev. Lett.;* **45**: No. 5, 358-362(4 Aug 1980).

NMR spin-lattice relaxation rates T_1^{-1} of ^1H in α-Si:H films exhibit a maximum near 40 K. Both the magnitude, the temperature, and frequences dependences of T_1 are well described by a model which assumes a coupling to disorder modes which are associated with some hydrogen atoms. Results suggest that some hydrogen sites may contribute to the electronic states within the gap.

RADIATION EFFECTS

35214 (DOE/EV/03861—T1) Vacuum ultraviolet electronic properties of liquids. Annual progress report, 1 November 1979-31 October 1980. Painter, L.R. (Tennessee Univ., Knoxville (USA). Dept. of Physics). 1980. Contract AS05-76EV03861. 20p. NTIS, PC A02/MF A01.

Areas covered are: optical and dielectric properties of hexamethyl-phosphoric triamide; photoemission from uv irradiated liquids; photon and photoelectron mean free paths in liquids; properties of Kapton films; and uv transmission of polycyclic organic molecules. (GHT)

CHEMISTRY

REFER ALSO TO CITATION(S) 35845, 35861

ANALYTICAL AND SEPARATIONS CHEMISTRY

35215 (FE—2710-11) Development of instrumental methods of analysis of sulfur compounds in coal process streams. Eleventh quarterly technical progress report, April-June 1980. Jordan, J. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Jul 1980. Contract AS01-77ET10482. 24p. NTIS, PC A02/MF A01.

Full implementation of an algorithm for calculating thermodynamic estimates of sulfur moiety concentrations is reported. The scope of the algorithm is unrestricted, including mononuclear and polynuclear sulfur species. Implementation is achieved through the use of substantiated numerical approximation. In Voltammetric Method Development, equations describing the analytic geometry of differential pulse voltammograms are reviewed critically. Work on appropriate refinements has been initiated. The analysis of mixtures of Bronsted-base moieties (OH^-, CO_3/sup =/, SO_3/sup =/ S/sup =/, SO_4/sup =/, S_2O_3/sup =/) by simultaneous thermometric and potentiometric (pH) titration with a strong acid has been explored. Sulfide or sulfite can be determined in the presence of hydroxide and carbonate with an accuracy of 4%, with the aid of simultaneous thermometric and potentiometric titrations. Sulfide in concentrations as high as 67% and thiosulfate in concentrations as high as 3.9% have been successfully determined in by-product waters from liquefaction and gasification processes by differential pulse polarography at a dropping mercury electrode. The samples were remarkable in that the concentration of sulfite is less than 12 ppM in all cases.

35216 (PNL-SA—8274) LC-MS using ion impact. Smith, R.D.; Burger, J.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980. Contract AC06-76RL01830. 3p. (CONF-800568—2). NTIS, PC A02/MF A01.

From 28. annual conference on mass spectrometry and allied topics; New York, NY, USA (25 May 1980).

A moving ribbon liquid chromatograph-mass spectrometer interface was constructed for operation with either secondary ion mass spectrometry or laser desorption ionization methods. Ions are analyzed using a quadrupole mass spectrometer. The operation is described in detail. (DLC)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

35217 (PNL-SA—7740) Tellurium interference in ^{129}I activation analysis. Kaye, J.H.; Brauer, F.P.; Strebin, R.S. Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 20 Sep 1979. Contract AC06-76RL01830. 16p. (CONF-791049—27). NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

Measurement of ^{129}I at low levels is required for effluent control, environmental assessment and tracer studies in the natural environment. Low level ^{129}I analysis has also been used for measurement of natural-fission-produced ^{129}I in minerals and ores as well as meteorites. The most sensitive method for ^{129}I measurements is neutron activation analysis of iodine separated from a suitable sample. Minimum sample processing prior to neutron activation is desirable in order to reduce chances of sample contamination with uranium or ^{129}I. A potential interference in the activation analysis method is the production of ^{129}I (^{130}I) from Te impurities in the irradiated ampoule. Procedures have been developed and applied to measurement of the magnitude of the potential Te interference. One-tenth of a microgram of Te in the irradiated ampoule is sufficient to produce interference in the analysis. This is detectable by either radiochemical Te measurements or by ^{131}I detection in the iodine fraction from the irradiated ampoule. This paper discusses the procedures and results of Te interference studies in ^{129}I activation analysis. The interference was found to be insignificant for most analyses. 5 tables.

35218 Determination of selenium in environmental materials by neutron activation and inorganic ion exchange. Knab, D.; Gladney, E.S. (Los Alamos Scientific Lab., NM). *Anal. Chem.;* **52**: No. 6, 825-828(May 1980).

A procedure for the determination of selenium in environmental samples is described. Neutron irradiated samples are dissolved in acid and ^{75}Se is adsorbed on an Al_2O_3 inorganic ion-exchange column from 5 M HCl-1 M H_3PO_4 solution. Tantalic acid is precipitated and filtered before loading on the column, which decreases interference from ^{181}Hf, ^{182}Ta, and ^{233}Pa. The adsorbed ^{75}Se is determined by Ge(Li) γ spectrometry. Selenium concentrations determined by the procedure in NBS reference materials and USGS rock standards compare well with certified and other reported values. 2 tables.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

35219 (LA—8460-MS) Neutron multiplication corrections for passive thermal neutron well counters. Krick, M.S. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 93p. NTIS, PC A05/MF A01.

Various techniques are surveyed for the neutron-multiplication correction of plutonium assays using thermal neutron coincidence counters. Examples are presented for a wide range of plutonium samples. Calculator programs for use with the High-Level Neutron Coincidence Counter (HLNCC) are described.

35220 (UCRL—52917) GRPANL: a program for fitting complex peak groupings for gamma and x-ray energies and intensities. Gunnink, R.; Ruhter, W.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 62p. NTIS, PC A04/MF A01.

GRPANL is a general-purpose peak-fitting program that calculates gamma-ray and x-ray energies and intensities from a given spectral region. The program requires that the user supply input information such as the first and last channels of the region, the channels to be used as pre- and post-region background, the system gain and zero-intercept, and a list of approximate energy values at which peaks occur in the region. Because the peak position and peak-shape parameters enter nonlinearly into the peak-fitting algorithm, an iterative least-square procedure is used in the fitting process. The program iterates until either all convergence criteria are met or ten iterations have elapsed. The code described here allows for twenty free parameters and a region as large as 240 data channels. This code runs on an LSI-11 computer with 32K memory and disk-storage capability.

35221 (UCRL—83402) Use of radioactive tracers for selection of rare earth precipitants and ignition temperatures. Smith, N.L.; Delucchi, E.S.; Mecozzi, D.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 5p. (CONF-791049—28). NTIS, PC A02/MF A01.

From 23. conference on analytical chemistry in energy technology; Gatlinburg, TN, USA (9 Oct 1979).

Variations have been found in the specific activity of ignited radioactive-labeled rare earth oxide samples. The variations appear to depend on the precipitating agents and temperatures. Using various precipitating agents and different ignition temperatures, samples of ^{88}Y-, ^{169}Tm-, and ^{173} ^{174}Lu-labeled oxides were produced from stock solutions. Observed specific activities were compared to the known specific activities of the starting solutions. At 800°C ignition temperatures, errors of 6% to 7% can be obtained for yttrium precipitated with 8-hydroxyquinoline or ammonia. Thulium and lutetium quinolates and cupferrates ignited at 800°C are in error by 3 to 5%. Results show that temperatures in excess of 1000°C are required for complete ignition of rare earth quinolates, cupferrates, hydroxides, and chlorides.

35222 Inaccuracies encountered in sulfur determination by particle induced x-ray emission. Hansen, L.D.; Ryder, J.F.; Mangelson, N.F.; Faucette, K.J.; Eatough, D.J. (Brigham Young Univ., Provo, UT). Contract EY-76-S-02-2988. *Anal. Chem.;* **52**: No. 6, 821-824(May 1980).

Negative errors as large as 50% may occur in particle induced x-ray emission (PIXE) determinations of sulfur concentration in environmental samples. The low values obtained by PIXE in this study are due to chemical reactions induced by irradiation and to loss of sulfur species which are volatile at the temperatures produced by the particle beam under some conditions. The use of small beam currents can eliminate the losses due to simple heating but not those due to radiation-induced reactions. 4 tables.

35223 (DP-TR—12) Gamma-ray spectrometeric determination of neptunium 237 in purification/extraction process solutions. Ertel, D.; Dressler, P. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Hochtemperatur-Chemie). 1979. Translation of KFK—2725. 21p. NTIS, PC A02/MF A01.

After quantitative separation from purification/extraction process solutions by means of TTA extraction, ^{237}Np was determined using semiconductor gamma-ray spectrometry using the low-energy peaks at 29 and/or 86 keV. The detection limit is about 0.1 mcg ^{237}Np/ml under realistic measurement conditions. For the purpose of analyzing the process, this method is less troublesome than ordinary alpha spectrometery and is faster than activation analysis.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 34496, 35398, 35652

35224 (DOE/EV/13573—T1, pp Paper 12, 13 pages) Measurements of ^{10}Be distributions using a Tandem Van de Graaff accelerator. Parker, P.D. (Yale Univ., New Haven, CT); Lanford, W.A.; Bauer, K.; Cochran, J.K.; Turekian, K.K.; Krishnaswami, S. 1979.

In Natural radioactive isotopes of beryllium in the environment.

Use of the Yale MP Tandem as a sensitive spectrometer to directly measure the ratio of $^{10}Be/^{9}Be$ atoms in samples of geophysical interest is discussed. The procedures used to measure absolute ^{10}Be contents of unknown samples are described.

35225 (DP—1560) Spectrophotometric determination of uranium(IV) with Arsenazo III. Baumann, E.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC09-76SR00001. 16p. NTIS, PC A02/MF A01.

A spectrophotometric procedure was developed for determining U(IV) in the presence of U(VI) by forming a colored complex with Arsenazo III in 4M HCl. The results compare satisfactorily with U(IV) determinations by ceric titration. Total uranium can be determined after reduction of U(VI) with metallic zinc. The concentration range for the absorbance cell solution is 0 to 2 μg U(IV)/mL. Other tetravalent ions, such as thorium, zirconium, hafnium, plutonium, and neptunium, will interfere.

35226 Sensitive in situ trace-gas detection by photothermal deflection spectroscopy. Fournier, D.; Boccara, A.C.; Amer, N.M.; Gerlach, R. (Laboratoire d'Optique Physique—Equipe de Recherche 5 du Centre National de la Recherche Scientifique, Ecole Superieure de Physique et Chimie Industrielles, 10 rue Vauquelin, 75231 Paris Cedex 05, France). *Appl. Phys. Lett.;* **37**: No. 6, 519-521(15 Sep 1980).

We present a sensitive (5ppb for ethylene, 10^{-7} cm^{-1}) and simple photothermal scheme for the detection of trace gases and measuring weak absorption in gas-phase samples. We also demonstrate the feasibility of this scheme for performing in situ measurements in the absence of sample cells or containers, thus eliminating the drawbacks of sampling and sampling techniques. Factors limiting our detectivity are discussed, and a comparison to the thermal lens effect is made.

35227 Matrix effects on the Raman analytical lines of oxyanions. Miller, A.G.; Macklin, J.A. Contract EY-77-06-1030. *Anal. Chem.;* **52**: No. 6, 807-812(May 1980).

The characteristics of Raman analytical lines are frequently affected by changes in the chemical environment of the vibrating molecule. Aqueous solutions containing pairs of the following anions, aluminate, ClO_4^-, CrO_4^{2-}, NO_3^-, PO_4^{3-}, SO_4^{2-}, and NO_2^- have been studied as a function of increasing Na^+ concentration. Typical effects noted are line broadening and a blue shift of the A_1 lines of high-symmetry oxyanions with increasing sodium content. Spectral changes are generally interpreted in terms of contact ion pair formation with sodium. Analytical ratios derived from the analytical lines of analyte and internal standard oxyanions are evaluated in terms of matrix independent character. The classical peak area ratio is not necessarily the best analytical measure of concentration. 11 figures, 2 tables.

35228 Determination of oxides of nitrogen (NO/sub x/) in cigarette smoke by chemiluminescent analysis. Jenkins, R.A.; Gill, B.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Anal. Chem.;* **52**: No. 6, 925-928(May 1980).

The successful application of a commercial chemiluminescent No/sub x/ analyzer to the determination of oxides of nitrogen in cigarette smoke is reported. Individual puffs of the smoke vapor phase are rapidly diluted in an air stream before introduction into the analyzer. This acts to both reduce quenching of the chemiluminescent response by CO_2 and to prevent side reactions of the NO/sub x/ with vapor phase organic constituents. Sweeping the dilute smoke through a reduced silver-ion exchange resin bed removed a substantial positive interference from hydrogen cyanide. A range of deliveries of 3 to 47 μmol of NO/sub x/ per cigarette was observed for nine types of experimental cigarettes. Statistically significant differences between NO/sub x/ and NO levels (NO/sub x/ - NO = NO_2) in smoke were observed in only one type of cigarette, presumably due to large cigarette-to-cigarette variability in constituent deliveries. 2 figures, 3 tables.

SEPARATION PROCEDURES

35229 (CONF-800918—5) **Size selective synergism by crown ethers in the extraction of alkali metals by di(2-ethylhexyl) phosphoric acid.** McDowell, W.J.; Kinard, W.F.; Shoun, R.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

From International solvent extraction conference; Liege, Belgium (6 Sep 1980).

Although the macrocyclic polyethers, known as crown ethers, complex metal ions and do so preferentially according to the size correspondance between the ion and the crown ether cavity, their usefulness as liquid-liquid extraction reagents has been limited by the necessity of solubilizing the anion in the organic phase. The common mineral acid anions are difficult to transfer to the organic phase and organophilic anions are expensive or impractical. A method is described that avoids this problem by combining organic-soluble cation exchangers with the crown ethers in the organic phase. The resulting mixtures show synergistic effect is size-selective. The size-dependence of the synergistic extraction in the system di(2-ethylhexyl) phosphoric acid/crown ethers parallels the extraction of picrate salts of the alkali metals and of the complex formation of the alkali picrates with crown ethers. A preliminary evaluation of concentration dependencies in the extraction of potassium by di(2-ethylhexyl) phosphoric acid-dicyclohexo-18-crown-6 mixtures in benzene suggests an organic phase complex containing two alkyl phosphoric acid groups and one crown ether per potassium.

35230 (COO—4073-4) **Chelating extractants of improved selectivity. Progress report, 1 August 1979-31 July 1980.** (Arizona Univ., Tucson (USA)). 1980. Contract AS02-76ER04073. 15p. NTIS, PC A02/MF A01.

During the current contract year, mixed ligand chelate extraction systems for separating lanthanides was extended to elucidating the underlying reasons for the observed enhancement by quaternary ammonium salts. Equilibrium studies reveal the formation of anionic complexes ($LnL_4.HL^-$) (where HL is 8-quinolinol) that was extracted when paired with a quaternary ammonium ion. Lathanum, as a lone exception was extracted as R_4N^+, LaL_4^-. Work is underway in the application of similar extractants, 5,7-dibromo-8-quinolinol and Kelex 100 (a 7-alkenyl-8-quinolinol) to the separation of lanthanides.

35231 (LA—8399) **Separation of trace uranium from plutonium for subsequent analysis.** Marsh, S.F. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 5p. NTIS, PC A02/MF A01.

Trace uranium quantities are separated from plutonium metal and plutonium oxide for subsequent analysis. Samples are dissolved in hydrobromic acid or a hydrobromic acid-hydrofluoric acid mixture. The U(VI)-halide complex is separated from nonsorbed Pu(III) on an anion exchange column using sequential washes of 9M HBr, a 0.1M HI-12M HCl mixture and 0.1M HCl.

35232 (PB—80-110430) **Coupled transport membranes for metal separations. Open file report (final), May 1975-May 1977.** Babcock, W.C.; Baker, R.W.; Kelly, D.J.; Lonsdale, H.K.; Ray, R.J. (Bend Research, Inc., OR (USA)). May 1977. Contract H0252066. 103p. NTIS, PC A06/MF A01.

The report describes the application of a new membrane process--coupled transport--primarily to separate and concentrate copper from dump leach liquors. The conditions for which copper was separated and concentrated from copper-iron solution were typical of those used in the hydrometallurgical-electrowinning process for extracting copper. An economic assessment based on results from small, bench-scale hollow fiber membrane modules indicates that processing copper leach liquors with coupled transport membranes should be competitive with the best current technology. Further feasibility studies were performed with uranium, iron, aluminum, and nickel-cobalt solutions. The process appears to be applicable to these solutions as well.

INORGANIC AND PHYSICAL CHEMISTRY

REFER ALSO TO CITATION(S) 35849

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 34483, 34484

35233 (DOE/EV/03801—T1) **Ecology of subtropical, shallow water environments: chemistry of copper and chlorine introduced into marine systems during energy production. Progress report, October 1, 1979-September 30, 1980.** Carpenter, J.H. (Miami Univ., FL (USA). Rosenstiel School of Marine and Atmospheric Sciences). 1980. Contract AS05-76EV03801. 39p. NTIS, PC A03/MF A01.

Research progress is reported in three areas. The first area concerns the chromatography of copper organic complexes. This work is a continuation of study from previous contract years. The second concerns the use of chemical degradation experiments to determine the nature of the binding sites for copper. The third area concerns the investigation of various separation methods with the aim of separating the copper chelating substances from the remaining organic matter.

35234 (IS-T—896) **Bonding in scandium monosulfide a NaCl crystal type.** Merrick, J.A. (Ames Lab., IA (USA)). Aug 1980. Contract W-7405-ENG-82. 152p. NTIS, PC A08/MF A01.

Thesis.

The transition temperature of an order-disorder transition in $Sc_{0.81}S$ (R anti 3m to Fm3m) occurs at 700°C. A group of ordered sublattices on the NaCl-type lattice (Fm3m) was generated and a Madelung energy and configurational entropy were calculated for each sublattice assuming the ions to be $Sc^{2.46+}$ and S^{2-}. Mean field and pair interaction approximations were used to model long-range and short-range orderings, respectively. The electrostatic model fails to predict the observed short-range and long-range orderings. The high temperature vaporization of ScP was investigated by mass spectrometry and target collection Knudsen effusion at 1767 to 2209K. The composition $ScP_{1.00}$ vaporizes congruently to the gaseous species Sc, P, and P_2. A temperature independent third law enthalpy of atomization ($\Delta H°$/sub atom,298/ = 252.2 +- 2.8 kcal $mole^{-1}$) has a value ~ 12 kcal larger than that reported for ScS. Nonrelativistic, nonself-consistent LAPW band structure calculations are reported for ScS. XPS and UPS measurements are reported for Sc_2S_3 and several compositions Sc/sub 1-x/S (0.0 ≦ x ≦ 0.2). The Sc and S 2p binding energies (XPS) obtained for the defect scandium monosulfides are very close to those found in the pure elements, suggesting covalent bonding. The Sc 2p energy region has an interesting satellite structure.

35235 (LBL—9690) **Models for calculation of dissociation energies of homonuclear diatomic molecules.** Brewer, L.; Winn, J.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Chemistry). Aug 1979. Contract W-7405-ENG-48. 29p. (CONF-800144—1). NTIS, PC A03/MF A01.

From Symposia of the Chemical Society no. 14 on diatomic metals and metallic clusters; Manchester, UK (Jan 1980).

The variation of known dissociation energies of the transition metal diatomics across the Periodic Table is rather irregular like the bulk sublimation enthalpy, suggesting that the valence-bond model for bulk metallic systems might be applicable to the gaseous diatomic molecules and the various intermediate clusters. Available dissociation energies were converted to valence-state bonding energies considering various degrees of promotion to optimize the bonding. The degree of promotion of electrons to increase the number of bonding electrons is smaller than for the bulk, but the trends in bonding energy parallel the behavior found for the bulk metals. Thus using the established trends in bonding energies for the bulk elements, it was possible to calculate all unknown dissociation energies to provide a complete table of dissociation energies for all M_2 molecules from H_2 to Lr_2. For solids such as Mg, Al, Si and most of the transition metals, large promotion energies are offset by strong bonding between the valence state atoms. The main question is whether bonding in the diatomics is adequate to sustain extensive promotion. The most extreme example for which a considerable difference would be expected between the bulk and the diatomics would be that of the Group IIA and IIB metals. The first section of this paper which deals with the alkaline earths Mg and Ca demonstrates a significant influence of the excited valence state even for these elements. The next section then expands the treatment to transition metals.

35236 Crossed molecular beams studies of the reactions of uranium with selected oxidizers. Lang, N.C.; Stern, R.C.; Finley, M.G.

(California Univ., Livermore (USA). Lawrence Livermore Lab.). *Chem. Phys. Lett.;* **69**: No. 2, 301-304(Jan 1980).

Angular distributions of UO produced from the reaction of U with O_2, NO, NO_2, and SO_2 were measured using crossed molecular beams. Total cross sections for these four reactions as well as for U + N_2O and U + CO_2 were estimated from product scattering signals. The cross sections range from 33 Angstroem^2 for U + NO to 1 Angstroem^2 for U + CO_2, and U + N_2O.

35237 Stabilization of praseodymium(IV) and terbium(IV) in aqueous carbonate solution. Hobart, D.E.; Young, J.P.; Norvell, V.E.; Mamantov, G.; Peterson, J.R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA)); Samhoun, K. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). *Inorg. Nucl. Chem. Lett.;* **16**: No. 5, 321-328(1980).

Praseodymium(IV) and terbium(IV) were prepared by electrolytic and chemical oxidation of the corresponding trivalent species dissolved in concentrated aqueous potassium and cesium carbonate solutions. A study of the potentiometric behavior of the Ce(IV)/Ce(III) couple in concentrated aqueous potassium carbonate was performed prior to the preparation of Pr(IV) and Tb(IV). Adjustment of the hydroxide ion concentration in the carbonate solutions, to approximately 1 molar, was necessary to provide stability for the tetravalent praseodymium and terbium species. The absorption spectra of the tri- and tetravalent species and the oxidation potentials of the Ln(IV)/Ln(III) couples in these aqueous carbonate media are reported.

35238 Enthalpies of solution and formation of Cs_2CO_3. Johnson, G.K.; Gayer, K.H. (Argonne National Lab., IL). *J. Chem. Thermodyn.;* **12**: 705-708(1980).

Enthalpy of solution measurements were undertaken to establish the enthalpy of formation of Cs_2CO_3. To suppress hydrolysis, enthalpy measurements were taken in 0.5 mol kg^{-1} CsOH. The standard enthalpy solution of Cs_2CO_3 was found to be -(56.38 +- 0.52) kJ mol^{-1} which is significantly more negative than that reported by Raffelini and LeVan whose measurements of dissolution of Cs_2CO_3 in H_2O is -(46.8 +- 2.6) kJ mol^{-1}. Because hydrolysis of carbonate ion is minimized in basic solution, it is believed that the enthalpy of solution obtained in this basic medium is more reliable.

35239 Hydrodenitrogenation over molybdenum-containing catalysts. Bhinde, M.V.; Shih, S.; Zawadski, R.; Katzer, J.R.; Kwart, H. (Univ. of Delaware, Newark). pp 184-187 of Chemistry and uses of molybdenum. Barry, H.F.; Mitchell, P.C.H. (eds.). Ann Arbor, MI; Climax Molybdenum Company (1979).

From 3. international conference on the chemistry and uses of molybdenum; Ann Arbor, MI, USA (19 Aug 1979).

Hydrodenitrogenation of quinoline and acridine was studied over Ni-W, Ni-Mo, and Co-Mo on Al_2O_3 in high-pressure liquid-phase microreactor. Reaction networks and reaction kinetics have been quantitatively determined as a function of catalyst and of pretreatment and reaction conditions. Hydrodenitrogenation requires ring hydrogenation prior to carbon-nitrogen bond scission and is bifunctional involving two catalyst sites: all of the reactions are kinetically important. Catalyst presulfiding and H_2S and dihydrogen partial pressure have opposite effects on hydrogenation and carbon-nitrogen bond scission reactions. Nickel-containing catalysts are more active than cobalt-containing catalysts because they more effectively promote hydrogenation. Hydrogenation of aromatics and of the aromatic ring structure of nitrogen-containing compounds occur on the same site on the metal sulfide, whereas hydrodesulfurization occurs on a different site. Carbon-nitrogen bond scission occurs on a still-different site, possibly associated with the support.

35240 Isopiestic studies of aqueous solutions at elevated temperatures. I. KCl, $CaCl_2$, and $MgCl_2$. Holmes, H.F.; Baes, C.F. Jr.; Mesmer, R.E. (Oak Ridge National Lab., TN). *J. Chem. Thermodyn.;* **10**: 983-996(1978).

Isopiestic studies have been made on aqueous solutions of KCl, $CaCl_2$, and $MgCl_2$ over the temperature range 382 to 474 K. Sodium chloride served as the reference solution and provided the basis for the calculation of osmotic coefficients. The molality range covered in this study correspond to about 1 to 6 mol kg^{-1} for NaCl. An equation recently developed by Pitzer was fitted to each set of osmotic coefficients with a standard deviation of fit (in the osmotic coefficient) ranging from 0.0009 to 0.0029. Parameters obtained from the fit were used to calculate activity coefficients. The activity coefficients showed a monotonic decrease with increasing temperature and became much less dependent on molality at the higher molalities. Osmotic coefficients of KCl and $CaCl_2$ solutions are consistent (by extrapolation) with existing low-temperature (<373 K) data. There are some serious discrepancies in report osmotic coefficients for $MgCl_2$ solutions. 9 figures, 2 tables.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

35241 (DOE/ER/00854—27) Gas chromatographic studies of the relative retention of the sulfur isotopes in carbonyl sulfide, carbon disulfide, and sulfur dioxide. Fetzer, J.C.; Rogers, L.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 18 Jan 1980. Contract AS09-76ER00854. 17p. NTIS, PC A02/MF A01.

A precision gas chromatograph, coupled to a quadrupole mass spectrometer and an on-line computer, was used to study the fractionation on Porasil A of the $^{32}S/^{34}S$ isotopic pair in a variety of sulfur-containing molecules. Carbonyl sulfide (COS) yielded an average α value of 1.00074 +- 0.00017 (standard deviation) for the temperature range 25°C to 75°C. The carbon disulfide (CS_2) value was 1.00069 +- 0.00023 for the range 53°C to 103°C, and that for sulfur dioxide (SO_2) was 1.00090 +- 0.00018 for the range 62°C to 112°C. Differential thermodynamic data have been reported. A Porapak Q column showed no fractionation of this isotopic pair in these three molecules.

35242 Laser isotope separation of $^{129}I_2$. Kushawaha, V.S. (Ames Lab., IA (USA)). *Opt. Quant. Electron.;* **12**: No. 3, 269-272(May 1980).

A report is presented on the selective excitation and separation of $^{129}I_2$, for the first time, in a laser induced chemical reaction of I_2 + C_2H_2 using the intracavity technique employed in the selective laser isotope separation of chlorine. For the present purpose, the B-X system of the I_2 molecule, which is extensively studied, was chosen. The photon absorption efficiency near 600 nm is fairly good. Also, there is no excited iodine atom production at this wavelength and the Rhodamine-6G pumped by Ar^+ laser has a very good power output. A detailed laser chemical kinetic study at this wavelength and others has been reported elsewhere.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 34652, 35233

35243 (AD-A—078379/5) Electron transfer initiated reactions of organic peroxides. The reaction of phthaloyl peroxide with olefins and other electron donors. Technical report. Schuster, G.B.; Zupancic, J.J.; Horn, K.A. (Illinois Univ., Urbana (USA). Dept. of Chemistry). 6 Dec 1979. Contract N00014-76-C-0745. 38p. NTIS, PC AA03/MF A01.

The reaction of phthaloyl with a variety of compounds capable of reacting as one or two electron donors was investigated. The products and the kinetics of these reactions indicate that the rate-limiting step is the transfer of one electron from the reactant to the peroxide. This conclusion was substantiated by investigating these reactions by laser flash photolysis. This study showed conclusively that odd electron intermediates are formed in the reaction of phthaloyl peroxide with ground and excited state electron donors. These reactions may be prototypical of a general class of transfer initiated transformations. (Author)

35244 (DOE/ER/04060—T1) Energies of organic compounds. Wiberg, K.B. (Yale Univ., New Haven, CT (USA). Dept. of Chemistry). 1 Jul 1980. Contract AS02-76ER04060. 24p. NTIS, PC A02/MF A01.

Automatic reaction calorimeters were developed. Enthalpies of hydration or hydrolysis were determined for polyoxygenated methanes, ketals, acetals, orthoesters, and alkenes. Trifluoroacetolysis of alkenes was carried out. Enthalpies of acetolysis and combustion of cyclopropane derivatives were also determined. Molecular mechanics calculations were carried out for ketones and ketals. Charge distribution in organic compounds were studied. 31 references. (DLC)

35245 Disordered crystal structure of bromodifluoroacetamide and trifluoroacetamide. Kalyanaraman, B.; Kispert, L.D.; Atwood, J.L. (Univ. of Alabama, Tuscaloosa). *Acta Crystallogr., Sect. B;* **34**: 1131-1136(1978).

$CBrF_2CONH_2$ and CF_3CONH_2 are monoclinic, space group $P2_1/n$, a = 7.501 (5), b = 8.263 (4), c = 8.611 (4) A, β = 106.19 (4)°, Z = 4, and a = 6.948 (7), b = 7.975 (3), c = 7.926 (7) A, β = 98.72 (5)°, Z = 4 respectively. The structures have been refined to R_1 indexes of 0.087 and 0.037, respectively, from 523 and 506 independent reflections measured on an x-ray diffractometer. They are isostructural. There is rotational disorder in the series CXF_2CONH_2 (where X = F, Cl, and Br) which appears to decrease with increasing C-X bond length. An electron spin resonance (ESR) single-crystal study supports the presence of disorder in these crystal structures. 6 figures, 7 tables.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 35004

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 35243

35246 (LBL—11259) **Excited-state proton-transfer kinetics in 1-naphthol, 1-naphthol-sulfonates, and organometallic complexes.** Shapiro, S.L.; Winn, K.R.; Clark, J.H. (Los Alamos Scientific Lab., NM (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 8p. (CONF-800656—4). NTIS, PC A02/MF A01.

From Picosecond meeting; Falmouth, MA, USA (18 Jun 1980).

The dissociation of 1-naphthol in aqueous solution occurs so rapidly that the fluorescence from the neutral form, ROH, has been previously described as completely extinguished or hardly noticeable. Apparently nearly all of the fluorescence originates from the naphtholate ion. This paper reports on the proton-transfer characteristics of a series of 1-naphthol compounds, and also reports preliminary data on excited-state proton transfer in an organometallic complex of ruthenium.

RADIATION CHEMISTRY

35247 (BNL—27841) **Radiation damage measurements on rock salt and other minerals for waste disposal applications. Quarterly report, January 1, 1980-March 31, 1980.** Swyler, K.J.; Loman, J.M.; Teutonico, L.J.; Elgort, G.E.; Levy, P.W. (Brookhaven National Lab., Upton, NY (USA)). 10 Apr 1980. Contract AC02-76CH00016. 31p. (ONWI/Sub—78/E511-01000-17). NTIS, PC A03/MF A01.

Different aspects of radiation damage in both synthetic NaCl crystals and various natural rock salt samples as well as granite, basalt and other minerals which will be important for radioactive waste disposal applications are being investigated. The principal means of measuring radiation damage is the determination of F-center concentrations, and the concentration and size of sodium metal colloid particles. Formation of these and other defects during irradiation and the annealing of defects and characterization of other processes occurring after irradiation are being studied as a function of dose rate, total dose, sample temperature during irradiation, strain applied prior to and during irradiation, etc. Measurements are being made on synthetic NaCl and natural rock salt samples from different geological locations, including some potential repository sites. It will be necessary to determine if radiation damage in the minerals from different localities is similar. If non-negligible differences are observed a detailed study must be made for each locality under consideration. Almost all current studies are being made on rock salt but other minerals particularly granite and basalt are being phased into the program. It is now established that radiation damage formation in both natural and synthetic rock salt is strongly dependent on strain. The strain related effects strongly indicate that the damage formation processes and in particular the colloid nucleation processes are related to the strain induced disolcations. A temporary theoretical effort has been started to determine which dislocation related effects are important for radiation damage processes and, most importantly, what dislocation interactions are most likely to create nucleation sites for colloid particles. If these preliminary studies indicate that additional theoretical studies will be useful an effort will be made to have them extended.

35248 (CONF-800944—3) **Early events in irradiated water.** Turner, J.E.; Magee, J.L.; Hamm, R.N.; Chatterjee, A.; Wright, H.A.; Ritchie, R.H. (Oak Ridge National Lab., TN (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From 7. symposium on microdosimetry; Oxford, UK (8 Sep 1980).

We propose a model to continue following events from the initial energy deposition ($<10^{-15}$ s) through later times at which liquid water can begin to respond chemically to the passage of radiation. We use a Monte Carlo code to calculate the spatial distributions of the chemical species present at times of about 10^{-11} s. This information provides the necessary input for diffusion-kinetic calculations to predict the subsequent chemical evolution of the system and measurable transient and steady-state yields. Calculations have been made of the correlations of the positions of various chemical species at 10^{-11} s, the distribution of net charge in volume elements of various sizes, and g-values for various species. These results are presented for water irradiated by 5 keV electrons.

35249 (COO—2086-91) **Radiolysis studies on reactive intermediates. Final report, February 1, 1970-August 31, 1980.** Kevan, L. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). Aug 1980. Contract AS02-76ER02086. 44p. NTIS, PC A03/MF A01.

Research highlights are briefly reviewed concerning studies of excess and solvated electrons, development of new electron spin resonance methods for maximizing the geometrical information about the surroundings of paramagnetic species in disordered systems, atom and ion solvation, and studies on other reactive intermediates. Titles of 155 research publications and 182 scientific talks presented on these areas are given.

35250 **Pulse radiolysis study of the reduction of neptunium(V) by the hydrated electron.** Schmidt, K.H.; Gordon, S.; Thompson, R.C.; Sullivan, J.C. (Argonne National Lab., IL (USA)). *J. Inorg. Nucl. Chem.;* **42**: No. 4, 611-615(1980).

The reduction of dioxoneptunium(V) by the hydrated electron and the consecutive reactions leading to the final partially hydrolyzed aquoneptunium(IV) species have been studied in aqueous perchlorate media under pulse irradiation. Additional parameters determined were $k_2 = 2.45 \times 10^{10}$ Lmol^{-1}s^{-1} for the rate of reaction of Np(V) with the hydrated electron, as well as Λ sub(NpO_2^+) = 20.4 +- 2.7 S cm^2 equiv.$^{-1}$. For the reactions: $Np(OH)_2^{2+} + H^+ = Np(OH)^{3+}$ and $NpO_2OH + H^+ = NpO_2^+$ respective values of pKsub(a) of 4.5 +- 0.5 and 8.7sub(-0.5)sup(+1.0) have been determined. A value of 1.5×10^6s^{-1} has been determined for the rearrangement of the unstable initial dioxoneptunium(V) to the fully hydrolyzed Np(IV) product.

35251 **$O(^3P)$ atom formation in γ-ray irradiated aqueous bromate solutions.** Hart, E.J.; Brown, W.G. (Argonne National Lab., IL (USA)). *Radiat. Phys. Chem.;* **15**: No. 2-3, 163-167(1980).

$O(^3P)$ atom formation in irradiated aqueous solutions was studied in the BrO_3^- concentration range from 0.01 to 2.0 mol dm^{-3} by measuring the ethylene resulting from the $O(^3P)$ atom reaction with cyclopentene (CP). Reaction of $O(^3P)$ with BrO_3^- attains significant proportions above 0.01 mol dm^{-3} with a relative rate constant $k(O(^3P) + BrO_3^-)/k(O(^3P) + CP)$ of 0.0058. This value was obtained from photolysis experiments at 253.7 and 313 nm. $G(C_2H_4)$ is reported for two concentrations of CP. The γ-ray induced formation of $O(^3P)$ is attributed to direct excitation of BrO_3^- by energy-rich secondary electrons, e$^-$sub(s) in competition with excitation of H_2O. Based on this simple competition mechanism it is deduced that BrO_3^- is of the order of 10 to 100 times more likely than H_2O to receive excitation energy from e$^-$sub(x).

35252 **Electron attachment to oxygen and other solutes in nonpolar liquids.** Holroyd, R.A.; Gangwer, T.E. (Brookhaven National Lab., Upton, NY (USA)). *Radiat. Phys. Chem.;* **15**: No. 2-3, 283-286(1980).

The rates of electron attachment to oxygen and other solutes are reported as a function of temperature for several high-electron-mobility liquids. Whereas the reaction with perfluorocyclobutane is fast in all solvents, that with oxygen is considerably slower. For both reactions the rates are energy dependent and are influenced by the energy (V_0) of the conduction band of the solvent as well as by the polarization energy (P^-) of the product anion. The activation energies can be accounted for in terms of changes in these energies.

35253 **Spur unfolding model for the radiolysis of water.** Magee, J.L.; Chatterjee, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Radiat. Phys. Chem.;* **15**: No. 2-3, 125-132(1980).

A previous treatment of the theory of the chemical action of high energy electrons contains the spur yield, Gsub(sp), as a parameter. Use of this theory allows one to obtain Gsub(sp) for any reaction for which sufficient experimental data are available. A model for the spur in dilute aqueous solution is considered here with the aim to provide some reaction details in that track entity. From the detailed considerations presented here, it appears that the size of the spurs must be taken as decreasing with the number of radical pairs initially present, if the radiation chemical yields are to be compatible with experiments. There is an unavoidable lack of uniqueness in such treatments which has led to the question of further comparison with experiments. This important question is also discussed.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 34593, 34992

35254 (PUB—112(Vol.4)) **History of Met Lab Section C-I, May 1945 to May 1946.** Seaborg, G.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1980. Contract W-7405-ENG-48. 657p. NTIS, PC A99/MF A01.

This is the final volume of a history of the research work of Seaborg and associates in the University of Chicago Metallurgical

Laboratory, Chemistry Section C-1. The work was concerned with the development of chemical procedures for the extraction of plutonium, for the purification of plutonium and, in the later phases, for research on the isotopes of other heavy elements including other transuranium elements. The style of the history is that of a diary with footnotes giving additional information.

35255 (UCID—18148) **Vapor-liquid equilibria for nitric acid-water and plutonium nitrate-nitric acid-water solutions.** Maimoni, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 62p. NTIS, PC A04/MF A01.

The liquid-vapor equilibrium data for nitric acid and nitric acid-plutnonium nitrate-water solutions were examined to develop correlations covering the range of conditions encountered in nuclear fuel reprocessing. The scanty available data for plutonium nitrate solutions are of poor quality but allow an order of magnitude estimate to be made. A formal thermodynamic analysis was attempted initially but was not successful due to the poor quality of the data as well as the complex chemical equilibria involved in the nitric acid and in the plutonium nitrate solutions. Thus, while there was no difficulty in correlating activity coefficients for nitric acid solutions over relatively narrow temperature ranges, attempts to extend the correlations over the range 25°C to the boiling point were not successful. The available data were then analyzed using empirical correlations from which normal boiling points and relative volatilities can be obtained over the concentration ranges 0 to 700 g/l Pu, 0 to 13 M nitric acid. Activity coefficients are required, however, if estimates of individual component vapor pressures are needed. The required ternary activity coefficients can be approximated from the correlations.

35256 **ν_4 fundamental of three isotopic species of CF_4.** Jones, L.H.; Krohn, B.J.; Kennedy, R.C. (Los Alamos Scientific Lab., NM). *J. Mol. Spectrosc.;* **70**: 288-293(1978).

The vibration-rotation spectra of the ν_4 fundamental of $^{12}CF_4$, $^{13}CF_4$, and $^{14}CF_4$ have been observed with 0.06 cm^{-1} resolution. A least squares fit of the data has been used to evaluate the pertinent molecular constants. The band centers are 631.199, 629.285, and 627.348 cm^{-1} for $^{12}CF_4$, $^{13}CF_4$, and $^{14}CF_4$, respectively. The Coriolis constant zeta$_4$ has been estimated for the three isotopes.

35257 **Fluorescence and excitation spectra of Bk^{3+}, Cf^{3+}, and Es^{3+} ions in single crystals of $LaCl_3$.** Hessler, J.P.; Caird, J.A.; Carnall, W.T.; Crosswhite, H.M.; Sjoblom, R.K.; Wagner, F. Jr. (Argonne National Lab., IL). pp 507-512 of Rare earths in modern science and technology. McCarthy, G.J.; Rhyne, J.J. (eds.). New York, NY; Plenum Publishing Corp. (1978).

Dye laser techniques have been used to study the energy level structure of the heavier actinides in single crystals of lanthanum chloride. In the case of einsteinium, fluorescence was detected and measured from the following manifolds: J = 5 at 0.984 μm^{-1}, J = 4 at 1.572 μm^{-1}, J = 6 at 2.930 μm^{-1}. This fluorescence was observed to the five lowest manifolds: J = 8, 5, 7, 2, 6. For californium, fluorescence has been detected from the manifolds: J = 11/2 at 1.190 μm^{-1}, J = 7/2 at 1.389 μm^{-1}, J = 5/2 at 1.977 μm^{-1}. This fluorescence was observed to the three lowest manifolds: J = 15/2, 9/2, 11/2. The fluorescence manifolds of berkelium are J = 6 at 1.540 μm^{-1}, and J = 4 at 1.953 μm^{-1}. The three lowest manifolds, J = 6, 5, and 4, have been observed in fluorescence. Absorption spectra data have yielded crystal-field splitting measurements in the higher manifolds of Es^{+}. The location of the manifolds in general confirmed earlier approximate free-ion level structure calculations based on assumed regularities in the energy level parameters derived from spectra of the actinide ions through Cf^{+}. 2 figures.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

35258 (AD-A—078090) **Experimental assessment of nitrogen oxides transformations while sampling combustion products. Interim scientific report.** Benson, R.C. (California Univ., Irvine (USA). Combustion Lab.). Jan 1978. 74p. NTIS, PC A04/MF A01.

Analysis of combustion products is performed by conveying the exhaust effluents to instrumentation by means of a sample probe and sampling line. Frequently, the selection of sampling materials does not consider potential chemical transformations that can occur in the sample line and probe. Nitrogen oxides are combustion products that are especially vulnerable to transformations. Nitric oxide (NO) and nitrogen dioxide (NO2) are the primary components of NOx. The ratio of NO/NO2 emissions from combustion sources is not well established (due to the potential reduction of NO2 to NO in sample probes and sample lines) and the total emission of NOx is subject to uncertainty in some cases (due to potential removal of NOx in sample probes and sample lines). The objective of the present study is to investigate the extent of transformations of NOx in the presence of oxidizing and reducing species. Stainless steel and silica were the two sampling tube materials used in this investigation. Simulated combustion products of 500 ppm NO, 75 ppm NO2, 12% CO2 bal N2 at 25 C were common to all tests. The oxidizing species and concentrations considered included 1 and 5% O2. Various concentrations of carbon monoxide, hydrogen, and hydrocarbons were used for the reducing species. Temperature and pressure effects were evaluated in this particular study. The reults indicated that transformation was more pronounced in stainless steel than silica.

35259 (PNL-SA—7912) **Modulated molecular beam mass spectrometric studies of the high temperature pyrolysis of hydrocarbons.** Smith, R.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1979. Contract AC06-76RL01830. 18p. (CONF-790893—3). NTIS, PC A02/MF A01.

From 8. international mass spectrometry conference; Oslo, Norway (11 Aug 1979).

The pyrolysis products of benzene and toluene were studied as functions of temperature (up to 2000°C) and pressure. Above 1400°C, most of the larger species are unstable; above 1700°C, no species heavier than C_6H_6 are observed at any pressure. Above 1500°C and at higher pressures, the products are dominated by species containing even numbers of carbon atoms (C_2 to C_{12}). While polyacetylenes up to C_8H_2 were observed, they are present in low abundances, with the max concentrations occurring at 1350°C. Polycyclic aromatic hydrocarbons are formed readily. 6 figures. (DLC)

ENGINEERING

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 35000, 35277, 35361

35260 (SAND—79-0423) **CF2256 cable assembly: development report.** Barber, E.R.; Donaldson, G.H. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 45p. NTIS, PC A03/MF A01.

The CF2256 is a multiwire, low-voltage cable contained in the W76-0/MK4 Reentry Body. It carries fuze presetting and actuator signals between the DOD cabling and the MC2912 Arming, Fuzing, and Firing assembly. The CF2256 successful development history is given along with some evaluation data. There is also an extensive list of references to assist in finding additional information.

35261 (SAND—80-1071) **Technique for calibrating V probes.** McClenahan, C.R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01.

V probes designed by Maxwell Laboratories, Inc. (MLI) have been extensively used at the Air Force Weapons Laboratory to measure the voltage of fast capacitor banks. The straightforward calibration method of pulsing a high voltage across the voltage probe typically produces only millivolts of output signal. Based on a suggestion by MLI, a new method to calibrate the probes has been devised. This technique, which uses a capacitive discharge and measures the dV/dt directly, has the advantage of producing an output signal of nearly a volt. A circuit has been designed and constructed to provide an appropriate ringing discharge which can be used to calibrate V probes. The theory of V probes and their calibration is discussed, and the construction and operation of the discharge circuit is presented. Finally, as an example of the calibration technique, details of how to calibrate a V probe are presented. A precision of 4% is readily attainable in the V probe calibration. Such accuracy should make possible routine 5% voltage measurements on pulsed power systems.

35262 (UCRL—52913) **Pneumatic controls for an LLL hydrostatic test facility.** Yanes, G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 31 Jan 1980. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01.

Pneumatic controls were installed on the high-pressure valving system for one of LLL's hydrostatic test facilities. Pneumatic controls were used because they can be programmed to perform selected functions by remote control and do not introduce electrical interference into the acoustic-emission instrumentation used to monitor a test. The pneumatically controlled valving system is relatively simple to operate. It eliminates hazards to the operator and is fail-safe if control air pressure is lost. Circuit and component descriptions, plus photographs of the system, are included in this report.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 35058, 35146, 35354

35263 (AD-A—078424/9) **Permanent magnet and superconducting generators in airborne, high power systems. Interim report 1 Feb 78-31 Mar 79.** Southall, H.L.; Brockhurst, F.C. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, OH (USA)). Aug 1979. 99p. NTIS, PC AA05/MF A01.

This report presents results of a study performed to compare airborne, high power supplies at power levels of 10 and 20 MW utilizing permanent magnet and superconducting generators. Algorithms for the weight and volume of these electrical generators are presented and algorithms for the other power supply components are used to predict total system weights for seven point designs at the two power levels.

35264 (PB—80-802655) **Josephson junctions (citations from the NTIS data base). Report for 1964-August 1978.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 237p. NTIS PCN01/MF N01.

The cited reports of Federally-funded research discuss the theory, design, fabrication, performance, and applications of Josephson junctions. References to such applications as far infrared radiation detectors, microwave detectors, voltage standards, noise thermometry, and magnetometry are included. (This updated bibliography contains 237 abstracts, 38 of which are new entries to the previous edition.)

35265 (PB—80-802663) **Josephson junctions. Volume 2. 1975-August 1978 (citations from the Engineering Index data base). Report for 1975-August 1978.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 295p. NTIS PCN01/MF N01.

The cited reports of worldwide research discuss theory, design, fabrication, performance, and applications of Josephson junctions. References to such applications as logic circuits, shift registers, data storage devices, far infrared detectors, microwave detectors, voltage standards, noise thermometry, and magnetometry are included. (This updated bibliography contains 295 abstracts, none of which are new entries to the previous edition.)

35266 (PB—80-802671) **Josephson junctions. Volume 3. September 1978-November 1979 (citations from the Engineering Index data base). Report for September 1978-November 1979.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 160p. NTIS PCN01/MF N01.

The cited reports of worldwide research discuss theory, design, fabrication, performance, and applications of Josephson junctions. References to such applications as logic circuits, shift registers, data storage devices, far infrared detectors, microwave detectors, voltage standards, noise thermometry, and magnetometry are included. (This updated bibliography contains 160 abstracts, all of which are new entries to the previous edition.)

35267 High input impedance wideband rf preamplifier for SQUIDs. Pang, C.S.; Falco, C.M.; Schuller, I.K. (Solid State Science Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Rev. Sci. Instrum.;* **51**: No. 9, 1272-1273(Sep 1980).

We describe a wideband rf preamplifier with high input impedance designed for operation of superconducting quantum interference devices (SQUIDs).

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 35372

LASERS

REFER ALSO TO CITATION(S) 35197

35268 Self-clinkering burning rate modifier for solid propellant NF_3-F_2 gas generators for chemical HF-DF lasers. Christe, K.O.; Schack, C.J. US Patent 4,163,773. 7 Aug 1979. Filed date 18 Dec 1978. 2p.

$N_2F_3SnF_5$ is formed by reacting $N_2F_3SbF_6$ and Cs_2SnF_6 in the presence of HF. $N_2F_3SnF_5$ is useful as a component of NF_3-F_2 gas generating compositions.

35269 (PB—80-803133) **Carbon monoxide lasers (citations from the NTIS data base). Report for 1964-December 1979.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 228p. NTIS PCN01/MF N01.

These abstracts of Federally-funded research reports cover gas discharge, gas dynamics, electron beam, and infrared and chemical lasers involving carbon monoxide as a lasing medium. Molecular excitation, energy transfer, and reaction kinetics are discussed. Studies on laser pumping are included. (This updated bibliography contains 221 abstracts, 11 of which are new entries to the previous edition.)

35270 (PB—80-803141) **Carbon monoxide lasers. Volume 2. 1978-December 1979 (citations from the Engineering Index data base). Report for 1978-December 1979.** Carrigan, B. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 149p. NTIS PCN01/MF N01.

Worldwide research on carbon monoxide laser excitation, plasmas, development, molecular reactions, equipment, optics, transitions, and gas mixtures are cited. Studies on optical pumping, gas dynamics, chemical reactions, kinetics, and performance are covered. (This updated bibliography contains 142 abstracts, 15 of which are new entries to the previous edition.)

35271 (UCRL—84082) **Intensification of rare gas halide lasers with application to laser fusion.** Jacobs, R.R.; Eimerl, D.; Goldhar, J.; Murray, J.R.; Rapoport, W.R.; Schlitt, L.; Swingle, J.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 19p. (CONF-800965—1). NTIS, PC A02/MF A01.

From European conference on optical systems and applications; Utrecht, Netherlands (23 Sep 1980).

The two techniques of backward-wave Raman pulse compression and pulse stacking are reviewed in the context of using KrF lasers as drivers in inertial confinement fusion. Experimental and theoretical results on Raman pulse compression in methane are presented including data on 70 to 75% pump energy extraction by the counter propagating Stokes wave. Results from on-going pulse stacker/Raman compressor experiments are also described, along with future investigations in this general area.

35272 Liquid nitrogen cooled laser rod holder design. Gettemy, D.; Barnes, N.P.; Griggs, E. (University of California, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). W-7405-ENG. 36. *Rev. Sci. Instrum.;* **51**: No. 9, 1194-1197(Sep 1980).

A reliable Ho:YLF laser system has been successfully developed. Problems encountered in laser-rod and support-system design were unique and most difficult to solve. These problems include holding a fragile laser rod having nonisotropic thermal expantion with vacuum tight seals which can be thermally cycled. Experimentally proven solutions are described which should help others in developing new solid-state laser systems.

35273 Rare-gas halide avalanche discharge lasers. Cze, R.C. (Los Alamos Sci Lab, NM). *IEEE J. Quant. Electron.;* **QE-15**: No. 12, 1338-1347(Dec 1979).

A summary is presented of a series of studies aimed at understanding rare-gas halide lasers excited by UV preionized avalanche discharges. Discussions include steady-state rate equation calculations of the kinetics, parametric variations and optimizations of discharge characteristics, and gas mixture optimizations for high-energy lasing. 45 refs.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 34682, 34921

35274 Calculation of the governing equations for a seriated unequal velocity, equal temperature two-phase continuum. Lyczkowski, R.W.; Solbrig, C.W. (Univ of Calif, Lawrence Livermore Lab). *AIChE J.;* **26**: No. 1, 89-98(Jan 1980).

The governing equations describing the flow of an unequal phase velocity, equal phase temperature (UVET) seriated two-phase continuum as derived by C.W. Solbrig and E.D. Hughes are solved, in one space dimension. A simple implicit iterative solution procedure is developed to numerically evaluate the five non-linear coupled field equations. Analytical solutions are developed, against which the computer code results are compared. The prototype UVET code results are compared to the equivalent equal phase velocity, equal phase temperature (EVET) code results for the same problem. Major phenomena such as phase flow reversal, countercurrent flow and flooding-like behavior are predicted. This work is pertinent to energy analysis, vertical pneumatic conveying, and fluidized beds. 11 refs.

MATERIALS TESTING

35275 (LA—8412-MS) **Industrial applications of computed tomography at Los Alamos Scientific Laboratory.** Kruger, R.P.; Morris, R.A.; Wecksung, G.W.; Wonn, G.; London, R. (Los Alamos Scientific Lab., NM (USA)). Jun 1980. Contract W-7405-ENG-36. 43p. NTIS, PC A03/MF A01.

A research and development program was begun two years ago at the Los Alamos Scientific Laboratory (LASL) to study nonmedical applications of computed tomography. This program had several goals. The first goal was to develop the necessary

reconstruction algorithms to accurately reconstruct cross sections of nonmedical industrial objects. The second goal was to be able to perform extensive tomographic simulations to determine the efficacy of tomographic reconstruction with a variety of hardware configurations. The final goal was to construct an inexpensive industrial prototype scanner with a high degree of design flexibility. The implementation of these program goals is described.

35276 (SAND—80-6019) **Miscellanea on terminal ballistics.** Weihrauch, G.; Lehr, H.F.; Wollman, E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Translated from PU 308/79, 36-109. 86p. NTIS, PC A05/MF A01.

Some terminal ballistics problems, which have in recent years received special attention in studies of kinetic energy penetrators at the Deutsch-Franzoesisches Forschungsinstitut Saint-Louis (ISL), are discussed. The scaling rules that allow modeling of the events are reviewed. Furthermore, the dynamic compression of cylindrical rods during impact on a rigid target is simulated numerically. In contrast to the usual continuum mechanical treatment, a model is used in which the rod represents a linear chain of mass points. Theoretical treatments of the dynamic-plastic buckling of cylindrical projectiles are also presented. Finally, the possible application of the strategy of evolution to the solution of a terminal ballistics problem is illustrated using the example of forward touch armor design.

ELECTRONIC CIRCUITS AND DEVICES

35277 (BDX—613-2277) **Whole new world of miniature technology.** Gillespie, L.K. (Bendix Corp., Kansas City, MO (USA)). Jul 1980. Contract AC04-76DP00613. 56p. (CONF-790568—2). NTIS, PC A04/MF A01.

From MINITECH 1, SME; Chicago, IL, USA (22 May 1979).

In the past ten years, miniaturization of both electrical and mechanical parts has significantly increased. Documentation of the design and production capabilities of miniaturization in the electronics industry is well-defined. Literature on the subject of miniaturization of metal piece parts, however, is hard to find. Some of the current capabilities in the manufacture of miniature metal piece parts or miniature features in larger piece parts are discussed.

35278 (BNL—51134, pp 336-339) **Recent developments in high power vacuum tube technology.** Faulkner, J.R. (EIMAC Division of Varian Assoc., San Carlos, CA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The use of pyrolytic graphite grid construction makes it possible to achieve the tight tolerances, close inter-element spacing, and dimensional stability necessary to produce high gain tubes capable of handling higher power per unit volume. Other new construction techniques and improved cooling methods which contribute further towards improvement in vacuum tube technology are also discussed.

35279 (SAND—79-2047) **Precision admittance measurements of coaxially-driven monopole antennas: an experimental study of junction effects.** Morris, M.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01.

Precision admittance measurements are presented for coaxially-driven tubular monopole antennas for a range of drive frequencies, antenna lengths, and drive geometry configurations. These precision admittance measurements were used to calculate junction effects and these junction effects are compared with the results of theoretical calculations. The admittances are also directly compared with computational results for the coaxially-driven monopole antenna.

35280 **Evidence of p/n homojunction formation in Zn_3P_2.** Catalano, A.; Bhushan, M. (Institute of Energy Conversion, University of Delaware, Newark, Delaware 19711). *Appl. Phys. Lett.;* **37**: No. 6, 567-569(15 Sep 1980).

Heating of magnesium/p-Zn_3P_2 contacts at 100 °C results in a $\sim 10^2$ lower reverse saturation current than found for the unheated metal-semiconductor diode. Spectral response and electron-beam-induced current (EBIC) measurements show the formation of a buried junction upon heating, and the latter method has been used to obtain values of junction depth and minority carrier diffusion length. A model expressing the collection efficiency of an n-on-p homojunction shows good agreement with experiment when the minority carrier diffusion lengths and junction depth determined by EBIC measurements are used. This is the first evidence that p/n homojunctions may be formed in Zn_3P_2.

35281 **Interpretation of the conductance and capacitance frequency dependence of hydrogenated amorphous silicon Schottky barrier diodes.** Viktorovitch, P.; Moddel, G. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138). DE-AC03-79-ET23037. *J. Appl. Phys.;* **51**: No. 9, 4847-4854(Sep 1980).

We present a general model of the frequency dependence of conductance and capacitance in a-Si:H Schottky diodes. In order to circumvent several questionable assumptions required in the analysis of capacitance voltage characteristics, the frequency dependence of sputtered a-Si:H devices is measured with no applied dc voltage. We obtain independent, consistent values of the depletion width and of the density of states at the Fermi level and below from both conductance and capacitance at both low and high modulation frequencies. We show that the linear frequency dependence of conductance cannot be attributed to hopping conductance, but rather to the interaction of gap states with free carriers. Our study shows that the interaction kinetics of the states around the Fermi level with the conduction-band carriers is so fast that the response of the diode is limited by the band transport of these carriers, which rapidly thermalize and distribute themselves through the continuum of states from the conduction band to the Fermi level.

35282 **Vibrating mirror drive circuit.** Hawthorne, A.R. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Rev. Sci. Instrum.;* **51**: No. 9, 1275-1276(Sep 1980).

A self-starting, stable, and symmetric driving circuit is described for use with a taut-band optical modulator such as a Bulova L50 or L51. The astable multivibrator consists of a capacitor, two resistors, three adjustment potentiometers, two diodes, and a dual operational amplifier. The circuit is particularly useful in applications requiring a small modulation amplitude that cannot be obtained from the factory-supplied driver.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 35101, 35104

35283 (CONF-800428—8) **Atmospheric fluidized bed combustion of municipal solid waste: test program results.** Preuit, L.C.; Wilson, K.B. (Combustion Power Co., Inc., Menlo Park, CA (USA)). May 1980. Contract AT03-76ET20068. 15p. NTIS, PC A02/MF A01.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

Air classified municipal solid waste (MSW) was fired in an atmospheric fluidized bed combustor at low excess air to simulate boiler conditions. The 7 ft^2 combustor at Combustion Power Company's energy laboratory in Menlo Park, CA, incorporates water tubes for heat extraction and recycles elutriated particles to the bed. System operation was stable while firing processed MSW for the duration of a 300-h test. Low excess air, low exhaust gas emissions, and constant bed temperature demonstrated feasibility of steam generation from fluidized bed combustion of MSW. During the 300-h test, combustion efficiency averaged 99%. Excess air was typically 44% while an average bed temperature of 1400°F and an average superficial gas velocity of 4.6 fps were maintained. Typical exhaust emission levels were 30 ppM SO_2, 160 ppM NO/sub x/, 200 ppM CO, and 25 ppM hydrocarbons. No agglomeration of bed material or detrimental change in fluidization properties was experienced. A conceptual design study of a full scale plant to be located at Stanford University was based on process conditions from the 300-h test. The plant would produce 250,000 lb/hr steam at the maximum firing rate of 1000 tons per day (TPD) processed MSW. The average 800 TPD firing rate would utilize approximately 1200 TPD raw MSW from surrounding communities. The Stanford Solid Waste energy Program was aimed at development of a MSW-fired fluidized bed boiler and cogeneration plant to supply most of the energy needs of Stanford University.

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 34461, 34462, 34463, 34498, 34499, 34500, 34501

35284 (AD-A—078889/3) **Ignition and flame propagation in sprays. Final report 1 jun 76-30 aug 79.** Sirignano, W.A.; Aggarwal, S.K. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). 1 Dec 1979. 47p. NTIS, PC AA03/MF A01.

Flame initiation and propagation through an air-fuel vapor-fuel drop system is numerically modeled in a cylindrical one-dimensional combustor. Using an unsteady formulation and allowing unsteady mass, momentum and heat transfer between the two phases, results have been obtained to observe the effects of activation energy, preexponential factor, intitial droplet size, initial temperature, stoichiometric ratio and diffusivity on the flame propagation. It is observed that the process is essentially unsteady. Also, unlike pre-

mixed case, heterogeneous combustion gives rise to large variation in fuel-air ratio, which could produce a secondary diffusion flame in the wake of a propagating flame. (Author)

35285 (EPRI-CS—1448) **Materials problems in fluidized-bed combustion systems: high-temperature erosion-corrosion by high-velocity (200ms/s) particles.** Barkalow, R.H.; Goebel, J.A.; Pettit, F.S. (Pratt and Whitney Aircraft, Middletown, CT (USA). Materials Engineering and Research Lab.). May 1980. 210p. NTIS, PC A10/MF A01.

The response of nickel- and cobalt base superalloys, aluminide coatings for these alloys, and Si_3N_4 to erosion-oxidation and erosion-hot corrosion conditions has been studied at 871°C (1600°F) in a high velocity gas stream 200 m/sec (656 ft/sec). The experiments were performed in a dynamic combustor (burner rig) operated on aircraft-grade jet fuel and compressed air. Erosive conditions were achieved by injecting abrasive powder into the burner rig. Alumina powders with average particle sizes of 20, 2.5, and 0.3 μm MgO were used as abrasive media. In the erosion-oxidation experiments, Si_3N_4 was much more resistant to degradation than all the metallic systems. For all the metallic systems it was found that: with 20 μm Al_2O_3 particles, material loss occurred because of mechanical erosion; with 2 μm Al_2O_3 particles, the materials degradation involved an interaction between oxidation and erosion such that the formation of Al_2O_3 scales inhibited erosion; deposition of 0.3 μm Al_2O_3 particles occurred on specimens and these particles did not establish an erosive component; and the magnitude of the erosive component increased as the hardness of the abrasive increased. Silicon nitride was much more resistant than the metallic systems in the erosion-hot corrosion test; erosion-hot corrosion using 2 μm Al_2O_3 occurred at rates greater than the sum of the rates of erosion and hot corrosion acting independent of one another; the interaction between hot corrosion and erosion was not affected by the particle hardness; and deposition of 0.3 μm Al_2O_3 during hot corrosion caused the degradation rates to decrease. The erosion-oxidation behavior of the metallic systems was consistent with the theory for ductile erosion. The synergism between erosion and hot corrosion occurs because each process establishes conditions that accelerate the other.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 35113, 35432

35286 (PB—80-108574) **Development of droplet sizing for the evaluation of scrubbing systems. Final report, June 1975-March 1977.** Medecki, H.; Wu, K.C.; Magnus, D.E. (KLD Associates, Inc., Huntington, NY (USA)). Jul 1979. Contract EPA-68-02-2111. 124p. NTIS, PC A06/MF A01.

The report describes the development and characteristics of the DC-2 Droplet Counter as used to evaluate scrubbing systems. The measurement of entrained droplets and their concentrations in gas streams is important in pollution control technology. The use of a hot-wire sensor can successfully measure the desired parameters for droplets in the size range from 1 to 500 micrometers. The report describes extensive testing in the laboratory and gives a comparison with results from the Brink impactor. A correlation of results for these two measurement techniques was achieved. The report also describes field tests at four different sites.

35287 (PB—80-112386) **Electrostatic precipitators for collection of high resistivity ash. Final report, November 1976-January 1979.** Pontius, D.H.; Bush, P.V.; Smith, W.B. (Southern Research Inst., Birmingham, AL (USA)). Aug 1979. Contract EPA-68-02-2193. 189p. NTIS, PC A09/MF A01.

The report gives results of a research program to: (1) compare various electrode systems for charging fine high-resistivity dusts; (2) investigate techniques for charging the dusts in a high current density corona system; (3) perform a laboratory scale feasibility study of selected charging systems; and (4) design, fabricate, and test a 0.47 cu m/sec (1000 acfm) pilot-scale precharger for application to a two-stage system for electrostatic precipitation of high resistivity particulates. A literature review of previous attempts to control back corona caused by high resistivity dusts, and limited theoretical and experimental investigations: eliminated the impracticable and evaluated potentially useful approaches to the development of charging systems for high resistivity dust, and resulted in the derivation of a new three-electrode particle precharger, upon which further developments were based. The three-electrode concept, tested in a small laboratory device, charged high resistivity dusts to levels achievable only on low and moderate resistivity dusts in conventional systems. Charging results remained good for a pilot scale system designed, built, and tested at a gas volume flowrate of 0.47 cu m/sec. A rugged version of the pilot scale precharger was tested as a part of a two-stage system, where the collector was a modified pilot scale ESP. The new technique has economic potential.

35288 (PB—80-112394) **Development of superior entrainment separators. Final report, October 1976-March 1979.** Calvert, S.; Barbarika, H.F. (Air Pollution Technology, Inc., San Diego, CA (USA)). Aug 1979. Contract EPA-68-02-2184. 163p. NTIS, PC A08/MF A01.

An experimental and theoretical program was carried out to develop an improved design for entrainment separators for scrubbers. The problems of separation efficiency, suspended solids deposition and plugging of the entrainment separator were of primary concern. A pilot scale entrainment separator (E.S.) coupled to a scrubber and designed to handle a nominal gas flow rate of 1.4 cu m/s (3000 ACFM) was designed, built and tested. Vertical discontinuous, zigzag baffles was the E.S. design selected after a review of both theory and practical experience with slurry scrubbers. The effect of E.S. performance on particulate emissions of a typical fossil-fueled boiler was evaluated. The experimental program included measurements of entrainment size distribution and loading, entrainment collection efficiency, solids deposition character and rate, and E.S. washing efficiency. Results were compared with available models and new criteria for effective washing were developed.

PARTICLE ACCELERATORS

35289 (BNL—51134) **Proceedings of the 1979 linear accelerator conference.** Witkover, R.L. (ed.). (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 451p. (CONF-790927—). NTIS, PC A20/MF A01.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Abstracts of individual items from the conference were prepared separately for the data base. (GHT)

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 35814

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 35330, 35331

35290 (BNL—28186) **Beam-beam interactions for bunched and unbunched beams.** Courant, E.D. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA)). 1980. Contract AC02-76CH00016. 8p. (CONF-800764—1). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Cern, Switzerland (10 Jul 1980).

The beam-beam interaction is analyzed in terms of Chirikov's stochasticity model. Stochastic blow-up occurs when the density of resonance regions in phase space becomes large, and Arnold diffusion is assumed to depend on the density parameter below the stochastic threshold. The relation between the density parameter and the tune shift ϵ is affected by bunching of the beam and also by variations in the strengths of several interaction regions and by beam misalignment. It is seen that bunching can reduce the tolerable ϵ by as much as an order of magnitude in proton storage rings.

35291 (BNL—51134, pp 118-121) **Precision beam formation in a 2 GeV linear accelerator of electrons.** Artyomov, V.I.; Vishnyakov, V.A.; Dovbnya, A.N.; Kovalenko, N.A. (Kharkov Physico Technical Inst., USSR). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Data is presented pertaining to the phase volume increase at the linac and beam transport system exits. Also, a comparison is drawn between two achromatic beam transport systems, showing that the quinti-lense system has certain clear-cut advantages over the tri-lens one.

35292 (BNL—51134, pp 129-137) **Low-beta linac structures.** Swenson, D.A. (Los Alamos Scientific Lab., NM). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The magnetically focused, post-coupled, drift-tube linac is the standard linac structure. It offers efficient acceleration and adequate focusing over a remarkably large range of beta from $\beta = 0.04$ to $\beta = 0.50$. The term low-beta linac structure has come to mean those linac structures that out-perform the standard Alvarez structure in the region below $\beta = 0.04$, and the term high-beta linac structure has come to mean those linac structures that out-perform the standard Alvarez structure in the region above $\beta = 0.50$. A companion to this paper will be presented in this conference on the subject of high-

beta linac structures. Low-beta linac structures are the bane of the existence of linac specialists. It is here that one must work hardest and achieve the least in the way of acceleration and focusing. The structures in this regon are characterized by inadequate focusing, limited apertures, and poor transit-time factors. It is here that the beams are the most poorly bunched, have the largest angular divergence, are the most susceptible to space-charge effects, and are thought to be the most vulnerable to emittance growth driving terms. Everything that is bad in linacs is worse at the low-beta end. Nevertheless, every linac has one, and work is continuing to develop and improve these structures.

35293 (BNL—51134, pp 197-201) **Modelling of biperiodic slow-wave structures.** Bukharin, V.L.; Novozhilov, A.Y.; Plink, O.V.;Sobenin, N.P.; Stepnov, V.V.; Shilov, V.K.; Shkolnikov, E.J. (Moscow Physics Engineering Inst., Moscow, USSR). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Two models are considered for defining the electrical parameters of biperiodic slow-wave structures (BSWS) with beam loading. The first model is represented by a chain of coupled cavities and the second one by a chain of lumped-parameters circuits. The feeding waveguide is accounted for in both models. Two computing programs which use a finite difference method on a square mesh are written. Some computational results are given.

35294 (BNL—51134, pp 217-222) **Influence of space charge on axial particle motion in heavy ion linacs.** Junior, P.; Deitinghoff, H.; Klein, H. (Universitaet Frankfurt/Main, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Considerations of beam dynamics for heavy ions within the frame of linear approximation at very low velocities are carried out. Decrease of acceptance due to space-charge for axial and radial motion is estimated. The behavior of idealized axial and radial beam envelopes with respect to space-charge and linac parameters is studied.

35295 (BNL—51134, pp 223-226) **Longitudinal current limit in a linac accelerating cell.** Kalnins, J.G. (Lawrence Berkeley Lab., CA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A simple analytical expression is derived for the maximum number of particles, and the corresponding average current, that can be transported in the longitudinal potential well of a linac cell. The calculation includes only the linear part of the self-fields, with the beam taken to be matched in the transverse phase space.

35296 (BNL—51134, pp 227-230) **Significance of beam optics concepts as applied to the new CERN linac.** Weiss, M. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The beam dynamics equations are in general valid only for ideal situations, i.e. ideal machines and ideal beams. To deal with reality, certain assumptions and procedures have to complement the theory so as to form with it a logical or reasonably logical entity. The beam dynamics approach used for the new CERN linac is reviewed and important points are underlined. Computer calculations justified the procedure at the start of construction; comparison with measurements and machine performance should now evaluate the true figure of merit of the whole approach.

35297 (BNL—51134, pp 245-248) **Focusing of high current beams in continuously rotated quadrupole systems.** Gluckstern, R.L. (Univ. of Maryland, College Park). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The recent development of high field permanent magnetic quadrupoles by Halbach, opens up their potential use in drift tube linacs, beam transport lines, etc. In order to retain some ability to adjust the focusing strength of a permanent quadrupole beam line, modification is proposed of the standard + - + - system to a system where adjacent quadrupoles are rotated (axially) with respect to one another by a constant angle, which can be adjusted to yield different focal strengths. The resulting motion in the two transverse directions is coupled, and requires a 4 x 4 matrix analysis to solve. However, a smoothed system consisting of continuously rotated quadrupoles can be solved analytically without invoking the usual alternating gradient matrix analysis. This has been done in this paper, which also extends the analysis to include properly matched, self-consistent, K-V space-charge distributions.

35298 (BNL—51134, pp 249-252) **Linear accelerators with intertank focusing.** Franczak, B.; Blasche, K.; Franzke, B. (Gesellschaft fuer Schwerionenforshung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Permanent magnetic quadrupole lenses with a rather small outer diameter could reduce the capacitive loading of rf-cavities due to drift tubes with a large diameter. However, they do not fit the needs of a heavy ion linear accelerator, where a large aperture and variable field gradients for a broad range of ions are required. Therefore a different approach was studied, which does not make use of drift tube quadrupole focusing: short accelerator cavities without quadrupole focusing and intersections between cavities, which provide radial focusing with magnetic quadrupole lenses and, eventually, even phase focusing by means of rebuncher cavities.

35299 (BNL—51134, pp 253-256) **Beam dynamics in a proton linear accelerator for a neutron spallation source.** Mittag, K. (Kernforschungszentrum Karlsruhe, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The frequency choice for a 600 MeV - 100mA pulse - 10 mA average proton linac is discussed. A 108-MHz Alvarez accelerates the protons from 500keV to 100 MeV; a 324-MHz high energy structure follows. Space charge effects play a dominant role in the beam dynamics. This choice of frequencies insures large longitudinal and transverse acceptances at injection, small longitudinal emittance blow-up in the Alvarez,and a large enough longitudinal acceptance of the high energy structure. The transverse emittance at injection must not be too small in order to alleviate transverse matching, and to avoid longitudinal emittance blow-up, which would lead to particle loss after transition.

35300 (BNL—51134, pp 291-296) **Longitudinal and transverse beam optimization at the Unilac.** Dahl, L.; Klabunde, J.; Strehl, P.; Schaa, V. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The different categories of beam optimization procedures are described, including both longitudinal and transverse phase planes. The description of the transverse computer-aided procedures concentrates on the low energy beam transport system, but these methods are applicable to the whole machine. In case of the longitudinal adjustment, typical procedures for the accelerator subsystems are presented. Present status, operating experiences and future development of the programs are reported.

35301 (BNL—51134, pp 304-308) **Calibration during installation and during initial operation of the CERN 50 MeV linac.** Warner, D.J. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

This paper describes the connection between the design and performance of the CERN 50-MeV linac made by the calibration aspects of the commissioning and first operation with beam. Essentially, one aims to set the accelerator working points for transverse and longitudinal motion. Both planes are treated under three main headings: alignment, calibration on installation, and calibration with beam. Results of perturbation measurements give detailed but relative fields, needing beam measurements in the longitudinal plane to fix the rf level and phase. The quadrupole calibrations are sensitive and absolute, but, apart from determining the input beam steering, the transverse beam measurements, so far, add little to the initial calibration.

35302 (BNL—51134, pp 309-313) **New linac three phase pulsed emittance measurement.** Tetu, P. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

To measure the new linac beam, a single pulse emittance system was developed which measures the beam pulse-to-pulse in the 3 planes.

35303 (BNL—51134, pp 319-323) **Single bunch acceleration and detection in s-band electron linear accelerator.** Tanaka, J. (KEK, Tsukuba, Japan); Sato, I.; Anami, S.; Fukuda, S.; Matsumoto, H.; Tabata, Y.; Kobayashi, H.; Tagawa, S.; Washio, M. 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Single bunches have been accelerated and directly monitored for pulse radiolysis studies since June 1977, at the 35-MeV S-band electron linac of the Nuclear Research Laboratory of the Univ. of Tokyo. An extremely short, picosecond-range single electron pulse was attained by means of a beam compressing injector and an ordinary TW type accelerator guide system. The measured maximum charge density of the single bunches was 1 nanocoulomb and the detected pulse duration was 16 picoseconds which is the limit of the monitoring detector. This report also describes the low jitter (less than 20 ps) triggering system for the detectors and the injector, and a few of the monitors to detect such a short pulse.

35304 (LBL—10755) **Beam-beam simulation for the single-pass collider.** Sah, R.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 7p. (CONF-800740—14). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The beam-beam interaction for the single-pass collider has been investigated by means of a computer simulation. The collision of a single intense bunch of electrons with a single intense bunch of positrons has been simulated using a macroparticle code in which the interaction between each two macroparticles is calculated directly. The simulation reveals the pinch effect of one bunch upon the other, the luminosity enhancement due to the pinch effect, the attraction between offset bunches, and the large opening angles of particles in the disrupted bunches. Finally, the effects of synchrotron radiaton emitted during the collision are simulated.

35305 (UCID—18768) **Model of beam head erosion.** Lee, E.P. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 8 Aug 1980. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01.

An analytical model of beam head dynamics is presented, leading to an estimate of the erosion rate due to the combined effects of Ohmic dissipation and scattering. Agreement with the results of a computer simulation and detailed one-dimensional computations is good in all respects except for the scaling of the erosion rate with net current.

AUXILIARIES AND COMPONENTS

ION SOURCES

35306 (ANL—80-73) **Informal workshop on intense polarized ion sources: a summary.** Schultz, P.F. (ed.). (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01.

An Informal Workshop on Intense Polarized Ion Sources was held on March 6, 1980, at the O'Hare Hilton Hotel, Chicago, Illinois. The purpose of the Workshop was to discuss problems in developing higher-intensity polarized proton sources, particularly the optically-pumped source recently proposed by L.W. Anderson of the University of Wisconsin. A summary of the discussions is reported.

35307 (BNL—51134, pp 420-423) **Tests with a multidipole ion source on the CERN 500-keV experimental pre-accelerator.** Grando, J.; Haseroth, H.; Hill, C.; Hone, M. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A pulsed, multidipole ion source (bucket ion source), similar to dc ones used in the fusion field for neutral injection, has been built and tested on an experimental pre-accelerator. Preliminary results are given and a comparision is made with the usual duoplasmatron ion source. Because of its very low noise, simple design, smaller number of variable parameters and lower power consumption, the eventual installation in the preinjector of the new CERN 50-MeV linac looks attractive.

35308 (BNL—51134, pp 424-427) **Development of a high brightness ion source.** Holmes, A.J.T.; Inman, M. (Culham Lab., Abingdon, Great Britian). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The brightness and emittance of an ion beam can depend on the ion temperature, aberrations and scattering, as well as other factors. However, it is the ion temperature which determines the irreducible minimum value of the emittance and hence brightness, as the other components can be eliminated by careful design. An ion source design is presented which has attained this minimum value for the emittance; the dependence of the ion temperature on the plasma source parameters is discussed.

35309 (BNL—51134, pp 436-439) **Development of high current heavy ion sources at GSI.** Keller, R.; Angert, N. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Reflex type sources and an ECR source are being investigated at GSI for the improvement of Unilac performance and new accelerator projects. In first runs with a reflex source, ion currents of up to 4 mA have been achieved for argon, krypton, xenon and mercury from 0.5 cm^2 extraction area. The beam brightness was in the range of 115 to 14 $A/(cm\ mr)^2$.

35310 (LA-UR—80-2274) **Survey of methods for rapid spin reversal.** McKibben, J.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 17p. (CONF-800824—21). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

The need for rapid spin reversal technique in polarization experiments is discussed. The ground-state atomic-beam source equipped with two rf transitions for hydrogen can be reversed rapidly, and is now in use on several accelerators. It is the optimum choice provided the accelerator can accept H^+ ions. At present all rapid reversal experiments using H^- ions are done with Lamb-shift sources; however, this is not a unique choice. Three methods for the reversal of the spin of the atomic beam within the Lamb-shift source are discussed in order of development. Coherent intensity and perhaps focus modulation seem to be the biggest problems in both types of sources. Methods for reducing these modulations in the Lamb-shift source are discussed. The same Lamb-shift apparatus is easily modified to provide information on the atomic physics of quenching of the 2S/sub 1/2/ states versus spin orientation, and this is also discussed. 2 figures.

INJECTION AND EXTRACTION SYSTEMS

35311 (BNL—51134, pp 37-42) **Linac efficiency and beam qualities in p, d, $_2{}^3$He and $_2{}^4$He acceleration.** Auclair, J.P.; Chamouard, P.A.; Lemaire, J.L. (Laboratoire National Saturne, C.E.N. Saclay, France). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Results of deuteron (d) and two helium isotopes ($_2{}^3He^{2+}$ and $_2{}^4He^{2+}$) acceleration with the 20 MeV SATURNE proton linac injector, operated in the $2\beta\lambda$ mode are presented. Included are discussions of operation of the ion source, low energy beam transport transparency, longitudinal and transverse matching to the linac, linac efficiency, consequences for the high energy beam transport tuning and the best achievements.

35312 (BNL—51134, pp 43-46) **Limitations and improvements of heavy ion acceleration with a 20-MeV proton linac.** Auclair, J.P.; Chamouard, P.A.; Lemaire, J.L. (Laboratoire National Saturne, S.E.N. Saclay, France). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

CRYEBIS will be the next heavy ion source to be installed in the 20-MeV proton linac injector for the strong focusing synchrotron SATURNE II. The possibilities offered in running the linac in the $2\beta\lambda$-mode and the limitations to accelerate heavy ions characterized by $\epsilon < 0.5$ (where $\epsilon = z/A$) were studied. Other proposed improvements to increase the efficiency of this injector are described.

35313 (BNL—51134, pp 364-366) **200 MHz fast phase shifters and phase detection for a ramping energy.** Auclair, J.P.; Chamouard, P.A.; Lemaire, J.L. (Laboratoire National Saturne, Saclay, France). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Injection using a ramped energy is required at Saturne. The mean energy is linearly increased during the 400 μs of injection by means of two rf cavities (ramping cavity and debuncher). The phase of each cavity is shifted relative to the linac phase. A set of fast phase shifters using strip-line techniques have been developed, which are presently in operation.

EXPERIMENTAL FACILITIES AND EQUIPMENT

35314 (BNL—51134, pp 1-4) **Applications of linear accelerators.** Blewett, J.P. (Brookhaven National Lab., Upton, NY). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Linear accelerator development is reviewed. Electron linacs in medical applications, radiography, and other areas are discussed. Uses of proton linear accelerators in medicine, isotope production and nuclear chemistry, and such exotic areas as meson collision facilities are also covered. Deuteron linacs, heavy ion accelerators, and superconducting linacs are discussed. (GHT)

35315 (BNL—51134, pp 5-7) **Design study of the Beijing 200 MeV proton linac.** Wang, S.H.; Lo, T.H.; Chang, Y.J.; Lo, Y.H. (Inst. of High Energy Physics, Beijing, China). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

In this paper a brief description of the design parameters of the Beijing 200 MeV Proton Linear Accelerator (BPL),some essential principles considered in the design and the three computer programs used are given.

35316 (BNL—51134, pp 17-20) **Unilac upgrading program.** Angert, N.; Boehne, D.; Klabunde, J.; Trautmann, H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

At the present time ions of the heaviest elements can be accelerated with the Unilac up to specific energies of 8.5 MeV/u with stripping in gas and upto 10 MeV/u with a foil stripper. Using a second foil stripper in front of the single-gap cavity structure 12.5 MeV/u can be reached. By adding two Alvarez tanks, the energy will be increased for the different operation modes to 14.5, 16.0 and 20 MeV/u respectively. Details of this energy increase project are described, which is to be realized by the end of 1981. Part of the upgrading program is also the modification of the Unilac for multi-ion beam operation and the construction of a new high-current injector.

35317 (BNL—51134, pp 28-31) **Status of the variable frequency heavy ion linac, RILAC.** Odera, M.; Chiba, Y.; Kambara, T. (Riken Inst., Saitama, Japan). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A variable frequency heavy ion linac is under construction at the Institute of Physical and Chemical Research (IPCR). The linac operates in π-3π and π-π modes and its acceleration frequency can be set between 17 and 45 MHz. The maximum energies of ions are 4 MeV/amu for light ions and 0.8 MeV. amu for heavy ions. The characteristics of the linac and the present status of the construction are reported in this paper. A plan for an energy booster of the linac is described.

35318 (BNL—51134, pp 32-36) **Accelerating structure parameters of the New England Nuclear Corp. proton linac.** Comastra, D. (New England Nuclear Corp., Billerica, MA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The design parameters of the New England Nuclear (NEN) 45-MeV Linac are presented. Emphasis is given to the small drift tube geometry used in conjunction with permanent magnet drift tube quadrupoles. Single cell and multi-cell rf cavity computations, as well as multiparticle dynamics results are discussed.

35319 (BNL—51134, pp 66-77) **New CERN 50-MeV linac.** Boltezar, E.; Haseroth, H.; Pirkl, W.; Plass, G.; Sherwood, T.; Tallgren, U.; Tetu, P.; Warner, D.; Weiss, M. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

In this invited paper the new CERN 50-MeV linac is described from several aspects including the general project background, a comparative treatment of services, components and phenomena along the beam, and some details of systems and techniques with emphasis on new approaches. A comprehensive list of references is included and a review of present status and performance.

35320 (BNL—51134, pp 88-93) **Rutherford laboratory 70-MeV linear accelerator.** West, N.D. (Rutherford Lab., Oxfordshire, England). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A 70-MeV proton linear accelerator, originally built as an injector for the Nimrod proton synchrotron, is described. The accelerator is now being modified to serve as the injector for a new rapid-cycling synchrotron which is being constructed for a pulsed neutron source facility.

35321 (BNL—51134, pp 94-97) **Status of the KEK injector linac.** Anami, S.; Baba, H.; Fukumoto, S. (National Lab. for High Energy Physics, Ibaraki, Japan). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

In April 1977, the KEK proton synchrotron started to run for experiments in high energy physics. Typical beam intensites of the injector are currently: 620 mA from the preinjector column 250-mA beam into the linac and 130 mA at the linac exit at 20 MeV. The rf system was modified to feed more power into the buncher and the debuncher. Rf windows, isolators, control system of the Cockcroft generator and an optical fiber data transfer system have been developed or improved. The linac beam of 200 mA has been achieved by removing grids from the buncher and lowering the column pressure of the preinjector. Although beam loading is not completely compensated in the accelerating field of the tank, the momentum spectrum of the beam is not seriously affected by the beam loading.

35322 (BNL—51134, pp 98-103) **Status report on the unilac.** Boehne, D. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

This paper outlines the present operation mode of the Unilac, including records of beam availability. The beam quality is described in terms of intensity, energy and microstructure. A review of component performance concentrates on problems with the injection and rf system. Comments on the status of the control system are also given.

35323 (BNL—51134, pp 109-113) **Operation of the Heidelberg heavy-ion postaccelerator.** Ingwersen, H.; Jaeschke,E.; Repnow, R.; Walcher, T.H.; Huck, B.; Kolb,B. (Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The 3MV-stage of the Heidelberg Heavy-Ion Postaccelerator went into operation in December 1977, and is in the state of full user availability since May of 1978. The machine uses spiral resonators at room temperature. Ten such resonators with design velocity β_0 = 0.10 at 108.48 MHz are operated either CW at 20 kW or in a pulsed mode (DF = 0.25) at 80 kW. Due to the flexibility of the independent phasing of the 10 resonators presently in operation, a wide variety of ions between ^{12}C and ^{79}Br have been accelerated for user experiments. Acceleration voltages as high as 3.3 MV (CW) and 5.5 MV (Pulsed Mode) could be demonstrated. An energy resolution of $\Delta E/E < 4 \times 10^{-4}$ allowing rebunched pulse widths of Δt/sub FWHM/ < 70 ps could be measured, showing the tandem-like beam quality. The machine is exclusively computer-controlled, a prerequisite for the operation of the many parameters of a tandem-postaccelerator-combination. The overall availability of the postaccelerator together with the MP Tandem was above 80% of the scheduled user beam time. The operation of the 3-MV stage is now interrupted for a 4-month shutdown till the end of 1979, to allow for the extension of the machine to its full 10 MV (CW) acceleration voltage by the addition of 20 more spiral resonators.

35324 (BNL—51134, pp 114-117) **Operation of the Karlsruhe superconducting post accelerator test section in the Saclay Tandem heavy ion beam.** Zieher, K.W. (Institute fuer Kernphysik, Karlsruhe, Germany); Hochschild, G.; Hornung, A.; Fouan, J.P.; Gastebois, J.; Joly, P. 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The test section of a superconducting heavy-ion post accelerator (SNB-Karlsruhe) was set up at the C.E.N.-Saclay Tandem Lab. It was operated with beam in order to demonstrate the feasibility of a superconducting booster accelerator for heavy ions behind a tandem accelerator. In addition, the cavities were used as a beam rebuncher. The energy modulation due to the test section was measured and reproduced the original calibration. In bunch experiments beam pulses were generated and measured.

35325 (BNL—51134, pp 122-126) **5-MeV electron linac with high energy resolution.** Vakhrushin, Y.P.; Nikolaev, V.M.; Rjactsov, A.V.; Svistunov, Y.A.; Severgin, Y.P.; Smirnov, V.L. (D.V. Efremov Scientific Research Inst. of Electrophysical Apparatus, Leningrad, USSR). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The design parameters of a 5-MeV electron linac with low energy spectrum and beam emittance are presented. The accelerator includes the following main components: (a) an injection system comprising an electron gun, rf chopper, and prebunching cavities, (b) a traveling-wave accelerating structure operating at room temperature, and (c) an active monochromatization system with variable longitudinal dispersion. Three-dimensional numerical studies of beam dynamics were performed taking into account space-charge forces. With the peak current of 3 mA, it is possible to obtain an energy spread less than $+- 5 \times 10^{-5}$ and a transverse emittance less than 1 mm-mrad.

35326 (BNL—51134, pp 148-151) **Work on rf quadrupole focusing structures at GSI.** Mueller, R.W. (Gesellschaft fuer Schwerionenforshung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Layouts have been made for a linac accelerating heavy ions ($^{238}U^{1+}$, 40 m long, or $^{238}U^{2+}$, 18 m long) from low energies up to 0.1 MeV/u, designed for high intensities and working at low duty cycle. At this energy the beam is to be stripped and transferred to the UNILAC, replacing the low brilliance ion sources for the planned synchrotron filling regime. Because of the need for very strong focusing, the linac must have rf quadrupole focusing which is similar in principle, but of different technical shape from those of Kapchinski -Teplyakov and the Los Alamos approaches. Also the rf cavity design is different. The frequency is typically low, around 10 MHz or lower. The linac will have the property of adiabatic bunching. This is a good condition for transporting beams of more than 10 mA, or even 1 ampere.

35327 (BNL—51134, pp 159-163) **Heavy ion post-accelerator with coupled spiral and split-ring resonators.** Schempp, A.; Klein, H.; Rohrbach, W.; Caspar, W.; Lotterbach, G.; Mueller, E. (Universitat Frankfurt/Main, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

At the single-ended 7-MV Van de Graff machine in Frankfurt, a smallpost-accelerator is being built, which will be partly used as a test facility for new linac structures. Therefore different types of resonators will be installed, starting with coupled spiral and split-ring resonators. Properties of these resonators and the status of the project are discussed.

35328 (BNL—51134, pp 180-183) **Beam loading experiments with a side-coupled structure.** McMichael, G.E.; McKeown, J.; Fraser, J.S. (Chalk River Nuclear Lab., Ontario). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Experiments to investigate the performance of side-coupled structures under heavy beam loading have been carried out with the Electron Test Accelerator at Chalk River. Initially, an 18-cell structure was excited at 805 MHz by a 1.4 MeV CW beam. The induced power dissipated in the structure shows a square-law dependence upon beam current (0.013 kW/mA^2) up to 12 mA. With an externally applied field to give an energy gain of 0.1 to 0.2 MeV/m, beam was accelerated under conditions designed to achieve greater than 80% beam loading, i.e. more than 80% of the klystron applied power was converted into beam power. These conditions are important in applications of accelerators to nuclear breeding.

35329 (BNL—51134, pp 184-189) **Detuning effect in a traveling wave type linac.** Arai, S.; Kobayashi, K.; Tojyo, E.; Yoshida, K. (Univ. of Tokyo, Japan). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A 15-MeV traveling wave type electron linac is used as the injector for the 1.3-GeV electron synchrotron at the Institute for Nuclear Study, University of Tokyo. The resonant frequency of this accelerator waveguide is 2758.00 MHz at 30°C. The performance of the linac,however, is improved when it is operated with a frequency which is higher than the design value by 200 to 400 KHz. It is shown that the detuning due to the beam loading is serious in such an accelerator waveguide in which the buncher and regular sections are combined, and the detuning effect can approximately be compensated by changing the operating frequency. The detuning effect in the traveling wave-type accelerator waveguide was studied both from experimental and theoretical aspects by using a short test waveguide.

35330 (BNL—51134, pp 194-196) **C-band superconducting cavity research at KEK.** Furuya,T.; Hosoyama, K.; Kato, T.; Kojima, Y.; Konno, O. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Fabrication and surface preparation techniques have been studied on C-band TM_{010} niobium single cavities. A Q_0 of 10^{10} and effective accelerating field strength of 10 MeV/m have been obtained by electro-polishing, anodizing and vacuum firing. Electron acceleration has been tested with a nine-cell π-mode structure. A preliminary test resulted in an accelerated beam at 0.64 MeV with 70 keV injection energy, corresponding to an effective accelerating field strength of 3 MeV/m.

35331 (BNL—51134, pp 257-261) **Phase adjusted focusing laser accelerator.** Huanwu, P.; Jiejia, Z. (Inst. of High Energy Physics, Beijing, China). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

In this paper a proposal is discussed to accelerate charged particles by an axially symmetrical electromagnetic field of a focusing laser. The axis of the field is the equilibrium orbit of the charged particles. It is shown that the charged particles can be focused transversally and longitudinally in the field. For continual acceleration of the charged particles, the phase of the incident laser has to be suitably adjusted. It is estimated that with an incident power density of 5 x 10^{10} W/cm^2, the effective energy gain for such an accelerator may be as high as 90 GeV/m, so the size and the cost of a Phase Adjusted Focusing Laser Accelerator (PAFLA) may be drastically reduced. This seems to offer an economical way to a super high energy accelerator.

35332 (BNL—51134, pp 274-278) **Distributed linac control system featuring SDLC loop communication.** Goodwin, R.W.; Shea, M.F. (Fermi National Accelerator Lab., Batavia, IL). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A distributed control system has been designed as a possible replacement for the existing analog and digital interface equipment in use at the Fermilab 200-MeV linear accelerator. In addition to replacing the present interface the present interface equipment that is no longer supported by the manufacturer, the goals for a new system include improved reliability, easier maintenance and faster monitoring of accelerator parameters. About 15 local microcomputers, one for each major linac system, would be fabricated from commercially available Multibus-compatible hardware. These local stations can operate as stand-alone systems, providing control and readout of parameters to facilitate maintenance of the accelerator components. Values of all critical devices can be monitored at the accelerator repetition rate (15 Hz), so that beam may be inhibited by any out-of-tolerance reading on a pulse-to-pulse basis, to prevent unnecessary and damaging beam loss.

35333 (BNL—51134, pp 286-290) **Computer controlled formation of the 750-keV accelerating column on the new CERN 50-MeV linac.** Haseroth, H. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The advantages of the simple design and construction of the CERN high gradient double gap accelerating column are partially counter-balanced by a sometimes (depending on vacuum conditions) lengthy and manpower wasting formation procedure. After the introduction of a radiation measuring facility, rather than the usual cathode current monitoring, as criterion for increasing the HV, a strategy has been worked out for automatic formation. This strategy has been implemented in a computer program to run on the Linac Control Computer (PDP 11/45). The advantages are: faster formation, smaller number of breakdowns and no operator needed. This paper describes the hard and software necessary and the teething problems.

35334 (BNL—51134, pp 297-303) **Measurements of energy, energy spread and bunch width at the Unilac.** Klabunde, J.; Schaa, V.; Schaffner, E.; Strehl, P.; Vilhjalmsson, H.; Wilms, D. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Characteristics of various beam diagnostic elements, including computation of signal shapes and signal processing, will be discussed. Some procedures for determination of beam parameters in longitudinal phase space are presented. Instrumentation and the computer program of a self-contained on-line energy measurement will be described.

35335 (BNL—51134, pp 340-343) **New England nuclear linac rf power system.** Lankshear, R.F. (New England Nuclear Corp., N. Billerica, MA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The proton linear accelerator, being constructed by the New England Nuclear Corporation, will have a design energy of 45 MeV and an average current of 5 mA. The machine will be energized by a pulsed rf power system with a 12% duty factor, providing 600-kW average and 5-MW peak power at 201.25 MHz.

35336 (BNL—51134, pp 344-347) **Rf-system of the CERN new linac.** Cuperus, J.; James, F.; Pirkl, W. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The rf-system of the CERN new linac consists of ten separate amplifier chains of modular construction, with individual fast amplitude and phase regulation systems, together with a slow tuning servo. All the servomechanisms act on the low-level part of each chain, without any highpower modulators. Constructional details of the rf hardware are given and performance figures presented.

35337 (BNL—51134, pp 348-355) **Recent improvements of the accelerator components at the Unilac.** Boehne, D.; Emmerling, M.; Gasper, A. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Experience with coupling devices of various designs for the Wideroee, Alvarez and single-gap cavity structures are reported. Dome windows suffer from pin holes in the ceramic if not properly coated. Large domes tend to implode. Coaxial feed throughs, if used in an unbakable design, develop copper deposits on the vacuum side. Improvements of the reliability of rf power lines by the suppression of transients and a redesigned ceramic support for the center conductor are described. For the single-gap cavities, with their inherently high frequency detuning under rf power, a capacitive tuner was conceived to replace the usual magnetic tuning slugs.

35338 (BNL—51134, pp 360-363) **Conditioning experiments on the 100% duty factor 3 MeV alvarez linac.** Chidley, B.G.; Ungrin, J.; Brown, J.C. (Chalk River Nuclear Lab., Ontario). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A number of difficulties have developed in the course of rf conditioning the 3-MeV Alvarez linac of the Chalk River Nuclear Laboratories High Current Test Facility. The tank had been designed with the drift tube stems avoiding contact with the tank wall

except via external vacuum bellows. This technique had been investigated in a prototype and although it gave satisfactory rf performance, overheating of the bellows limited operation to 25% of operating power. An internal rf shield has been developed which has allowed tank excitation up to the design field level.

35339 (BNL—51134, pp 367-369) **High power isolator for the KEK proton linac.** Anami, S. (NEN, Tsukuba, Japan); Baba, H.; Mori, Y.; Tanaka, J.; Fukumoto, S.; Takenaka, T.; Kubota, C.; Ito, K.; Sakaue, T.; Shinohara, K. 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A high power 200-MHz isolator was developed at the KEK proton linac in order to reduce coupling interaction between the linac tank and the amplifier and to ease the operational tuning of the linac. The isolator consists of a ferrite-loaded circulator with three coaxial ports and a high power rf dummy load. The operational rf peak power is more than 2 MW and the VSWR, the isolation and the insertion loss are 1.2:1, 20 dB and 0.5 dB respectively. The operational performance of the linac using the isolator is also described.

35340 (BNL—51134, pp 373-379) **Drift tube and beam line quadrupole permaNENt magnets for the nen proton linac.** Holsinger, R.F. (New England Nuclear Corp., N. Billerica, MA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

One hundred and nine permanent magnet quadrupoles of the new Halbach type will be installed in the drift tubes of the 45-MeV NEN proton linac. This new design concept utilizes, in a unique way, the anisotropy and other magnetic properties of oriented samarium-cobalt magnets to achieve high pole-tip fields and efficient use of the material. All of the drift tube quadrupoles have been designed, and the first group of 35 have been fabricated and measured. Prototype design work and computer modeling studies of similar large aperture permanent magnet quadrupoles, for the high energy beam transport system of the NEN linac, have been completed. These beam line quadrupoles will incorporate mechanisms by which their focusing strength may be adjusted.

35341 (BNL—51134, pp 380-383) **Tipless permanent magnet quadrupole lenses.** Lazarev, N.V.; Skachkov, V.S. (Inst. for Teoretical and Experimental Physics, Moscow, USSR). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

Tipless quadrupole lenses of the rod type are proposed. Lenses with samarium-cobalt rods and $<$ 2-cm aperture ensure a magnetic field gradient up to 6 kG/cm and allow regulation of the operating field over a wide range. The advantages of these lenses in comparison with conventional ones are shown.

35342 (BNL—51134, pp 384-387) **Mechanical aspects of the New England nuclear linac.** Damm, R.; Aggus, J.; Greenberg, G. (New England Nuclear Corp., N. Billerica, MA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

New England Nuclear Corporation (NEN) is building a 45-MeV proton linear accelerator, to be used for the commercial production of radiopharmaceuticals. The design goal of 5-mA average current at 60 pps and the use of permanent magnet drift tube quadrupoles will make this machine unique. In order to minimize risk, reduce costs and speed fabrication, this machine is being modeled after existing proton linacs in the US and Europe. This paper reviews some of the mechanical designs that are being used. Single stem drift tubes with a choke joint connection to the tank wall are discussed. Tank design and cooling and reviewed along with rf problems, such as loop design and transmission line cooling. Beam transport in the dome and the LEBT, along with the machine vacuum systems are discussed. The column design and its support are presented. Conventional alignment techniques are planned and reviewed. The linac building and the schedule is presented.

35343 (BNL—51134, pp 388-391) **Cavity and drift tube technology for the upgraded Unilac.** Boehne, D.; Gaiser, H.; Malwitz, E. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Germany). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The extension of the Unilac poststripper section from the present 2 to 4 Alvarez cavities should be completed as early as possible. There was, however, concern whether the old drawings should be used with the appropriate changes in the drift tube table, or a redesign of essential mechanical details (simplifications) would be possible in the tight time schedule. As a result, the saving in fabrication time seems to compare favorably with the effort spent in redesigning the cavity and drift tubes. The net gain would be a cost saving of a factor of two. This paper describes an in-place plating method for welded tank sections and a fabrication scheme for the drift tubes out of inexpensive sheet metal components.

35344 (BNL—51134, pp 392-395) **Mechanical design of CERN new linac accelerating structure.** Boltezar, E. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

This paper outlines the mechanical engineering design philosophy and gives a short description of major components, assembly methods and performance of the Alvarez structure for CERN's new 50-MeV proton linear accelerator now in operation as the injector for a complex of high energy machines. It replaced the old linac which could no longer satisfy the demands for a proton beam of higher peak current and better quality. Some of the design details mentioned in this paper, such as drift tube demountable girders and the alignment method, were first tried on the 3-MeV experimental linac built at CERN. Some production technologies, like copper clad steel, have been used on existing linacs. However, there are several new features incorporated in this Alvarez structure which are novel in the field of linac design.

35345 (BNL—51134, pp 444-447) **Compensation for beam loading on the preinjector of the new CERN 50 MeV linac.** Haseroth, H.; Hone, M.; Vallet, J.L. (CERN, Geneva, Switzerland). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The original two-tube bouncer built by Haefely has been replaced by a single tube bouncer featuring a simpler and cheaper design, without compromising on the precision of the HV regulation. This paper describes the basic design and construction of the new system, putting special emphasis on reliability and ease of maintenance.

35346 (BNL—51134, pp 448-452) **Design criteria for high voltage, high current accelerating columns.** Hepburn, J.D.; Ungrin, J.; Shubaly, M.R.; Chidley, B.G. (Chalk River Nuclear Lab., Ontario). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

A continuing development program has increased the reliability of two 100% duty factor single-stage accelerating columns at the Chalk River Nuclear Laboratories. Experiments on the two columns have included studies in gap voltage, accelerating gradients, extraction geometry, electrode materials and shape, column bleed current, insulator design, and the effect of backstreaming electrons. A set of design criteria for accelerating columns, based on these experiments, has been formulated. While the reliability of the existing single-stage columns has been improved, the criteria can best be satisfied by a two-stage accelerating system with ion species separation and beam shaping between a low voltage ion source and the main accelerating column.

35347 (BNL—51134, pp 462-464) **Pre-accelerator for the NEN linac.** Bentley, R.F. (New England Nuclear Corp., N. Billerica, MA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

The design of the ion source, mass selector, accelerating column and transport system is described for a 780-keV proton beam of 8-mA average current. Departures from previous linac preaccelerator designs to achieve this current include a cusp field bucket ion source and a 90° analysis bend in the high voltage terminal prior to the second acceleration stage to 780 keV. The layout, beam optics and design philosophy are presented.

35348 (BNL—51181) **Microwave longitudinal coupling impedance in ISABELLE vacuum chamber.** Giordano, S.; Votruba, J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1980. Contract AC02-76CH00016. 13p. NTIS, PC A02/MF A01.

The purpose of this paper is to investigate the modes above the cutoff frequency of the ISABELLE vacuum chamber, and to measure some typical values of the longitudinal coupling impedance. (The investigation was limited to only those modes that have fields in the beam pipe.) Measurements show that the impedance, Z, between 2.6 and 2.8 GHz, can be as high as 10 x n ohms, where n is the ratio of the excitation frequency of the beam divided by the fundamental rotational frequency of the ISABELLE ring. Future work calls for an investigation of the coupling impedance above 2.8 GHz; preliminary work indicates that these impedances Z/n, can be considerably higher than 10 ohms.

35349 (BNL—51209) **Resonators for heavily beam-loaded linacs.** Sanders, R.T. (Brookhaven National Lab., Upton, NY (USA)). 28 Apr 1980. Contract AC02-76CH00016. 27p. NTIS, PC A03/MF A01.

Capacitively loaded resonant line section accelerating structures are discussed. Prototype models were measured at low levels, and calculations were made to predict high level operation. High current composite beams of multiple-beamlets as accelerated by a MEQALAC were assumed.

35350 (UCID—18733) **Pulsed power for particle beam accelerators in military applications.** Smith, I.D. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 20 Jun 1980. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01.

Techniques useful for generating and conditioning power for high energy pulsed accelerators with potential weapon applications are described. Pulsed electron accelerators are exemplified by ETA and ATA at Lawrence Livermore Laboratories and RADLAC at Sandia Laboratories Albuquerque. Pulse-power techniques used in other applications are briefly mentioned, including some that may be useful for collective ion accelerators. The limitations of pulse-power and the general directions of desirable development are illustrated. The main needs are to increase repetition rate and to decrease size.

35351 **Antiproton—proton colliders and intermediate Bosons.** Cline, D.; Rubbia, C. (University of Wisconsin). *Phys. Today;* **33**: No. 8, 44-47(Aug 1980).

Phase-space cooling makes p-barp colliders practical; CERN and Fermilab plan to use them to find and measure the properties of the intermediate Vector Bosons.

35352 **Preparation of actinide targets for the synthesis of transactinide elements.** Lougheed, R.W.; Hulet, E.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Nucl. Instrum. Methods;* **166**: No. 3, 329-332(1 Dec 1979).

We describe a new process for producing actinide targets suitable for heavy-ion bombardment. The targets have been prepared by vacuum sublimation of the actinide trifluorides onto substrates of thin Be or Al foils. Areal densities of up to 2.4 mg/cm^2 have been easily attained for targets 6 mm in diameter. By this process, we have prepared over thirty targets of ^{241}Am, ^{248}Cm, ^{249}Bk and ^{249}Cf, and have bombarded these with heavy ions ranging from ^{12}C to ^{48}Ca. The apparatus and method of subliming the actinide and lanthanide trifluorides are described and an illustration of the advantages (discovery of element 106) of such targets is presented.

STORAGE RINGS

35353 (BNL—28149) **Synchrotron radiation sources for photobiology and ultraviolet, visible and infrared spectroscopy.** Sutherland, J.C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 9p. (CONF-800762—1). NTIS, PC A02/MF A01.

From 8. international congress on photo-biology; Strasbourg, France (20 Jul 1980).

The advantages of synchrotron radiation in several types of spectroscopy, microscopy and diffraction studies are clear. The availability of synchrotron radiation will expand rapidly in the early 1980's as experimental programs start at the new generation of dedicated storage rings.

35354 (DESY—79/48, pp 97-120) **Isabelle superconducting magnets.** Sampson, W.B. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979.

From Study of an electron-proton facility for Europe; Hamburg, F.R. Germany (2 Apr 1979).

In this paper the details of the design are outlined and recent results from commercially produced coils are summarized. Some suggestions are included on how the design might be modified to match the requirements of the proposed proton ring for the PETRA machine.

INSTRUMENTATION

RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 35379

GENERAL DETECTORS AND MONITORS

35355 (ORNL/TM—7384) **User's guide for revised SPEC-4 neutron spectrum unfolding code.** Johnson, J.O.; Ingersoll, D.T. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 64p. NTIS, PC A04/MF A01.

The SPEC-4 computer code was developed in the United Kingdom to solve the spectrum unfolding problem for spherical gas-filled proton-recoil neutron spectrometers. This report describes the ORNL version of SPEC-4 which has been applied to the analysis of data from the Tower Shielding Facility. Recent modifications are described which largely pertain to the graphical output routines. In addition, the input requirements are presented in considerable detail including suggestions and recommendations based on actual operating experience. Finally, auxiliary programs are discussed which can aid the SPEC-4 user.

35356 (PB—80-129778) **Quality assurance for fluoroscopic x-ray units and associated equipment. Final report.** Hendee, W.R.; Rossi, R.P. (Colorado Univ., Denver (USA). Medical Center). Oct 1979. Contract FDA-AD-39. 98p. NTIS, PC A05/MF A01.

The manual provides detailed QA procedures for fluoroscopy, image intensifiers, and associated equipment. Included are data analysis techniques and recommendations for taking corrective measures. The procedures described in this manual are based on the techniques and equipment used by the contractor. Comparable equipment from other manufacturers may serve equally well in performance of these tests. This and related manuals provide the basis for a comprehensive QA program in diagnostic radiology.

35357 **Coded aperture imaging with uniformly redundant arrays.** Fenimore, E.E.; Cannon, T.M. (to Dept. of Energy). US Patent 4,209,780. 24 Jun 1980. Filed date 2 May 1978. 10p.

PAT-APPL-902,183.

A system is described which uses uniformly redundant arrays to image non-focusable radiation. The array is used in conjunction with a balanced correlation technique to provide a system with no artifacts so that virtually limitless signal-to-noise ratio is obtained with high transmission characteristics. The array is mosaicked to reduce required detector size over conventional array detectors. 15 claims.

35358 **New experimental approaches to the detection of solar neutrinos.** Freedman, M.S. (Argonne National Lab., IL (USA)). *Bull. Inst. Chem. Res., Kyoto Univ.;* **57**: No. 1, 117-129(Mar 1979).

The cosmological implications of the low result of the famous Davis experiment on ^{37}Cl to measure the flux on earth of the high energy component of the solar neutrino emission is discussed. It is now considered imperative to determine whether the reason lies in some defect of the standard solar model or in our understanding of the relevant nuclear physics of the postulated hydrogenburning fusion reactions in the solar core or of the physics of electron neutrinos. Such determination depends on a difficult measurement of the flux of the low energy component of the solar neutrino emission, that produced by the primary proton-proton fusion. Four proposed experiments designed to measure that flux, using targets of ^{7}Li, ^{71}Ga, ^{115}In, and ^{205}Tl are described and compared.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 35768

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 35667

35359 (FERMILAB-CONF—79/86-EXP) **Construction and performance of large flash chambers.** Taylor, F.E.; Bogert, D.; Fisk, R.; Stutte, L.; Walker, J.K.; Wolfson, J.; Abolins, M.; Ernwein, J.; Owen, D.; Lyons, T. (Fermi National Accelerator Lab., Batavia, IL (USA); Michigan State Univ., East Lansing (USA); Massachusetts Inst. of Tech., Cambridge (USA)). 1979. Contract AC02-76CH03000. 9p. (CONF-791037—32). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

The construction and performance of 12' x 12' flash chambers used in a 340 ton neutrino detector under construction at Fermilab is described. The flash chambers supply digital information with a spatial resolution of 0.2", and are used to finely sample the shower development of the reaction products of neutrino interactions. The flash chambers are easy and inexpensive to build and are electronically read out.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 34488, 35156

35360 (BNL—28267) **Water vapor pressure gauge.** Edwards, D. Jr.; Gillette, D. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 9p. (CONF-801037—7). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

An inexpensive pressure gauge, able to measure the N_2 and H_2O components within a vacuum system in the pressure range 1μ to 400μ is described and results of tests of the device are reported.

35361 (GEPP-LR—546) **Limit parametric study, Area 116 holobeam laser welder.** LaBuff, H.P. (General Electric Co., St. Peters-

burg, FL (USA). Neutron Devices Dept.). 15 Sep 1980. Contract AC04-76DP00656. 44p. NTIS, PC A03/MF A01.

The Holobeam Laser welder in Area 116 had been modified to make it identical, for all practical purposes, with the one in Engineering. Mr. EJ Furno, who has been experimenting with the Engineering laser welder, had recommended that the laser be operated without the up-collimator. This was to make the operation of the laser less sensitive to depth-of-focus problems. This was verified by the instruction manual at an outside seminar on laser operation. Process Technology had no information on the effect of removing the up-collimator on the spot size and penetration. Therefore, this limited parametric study was undertaken.

35362 (HEDL-SA—2098-FP) **Combining within and between instrument information to estimate precision.** Jost, J.W.; Devary, J.L.; Ward, J.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 17p. (CONF-800820—9). NTIS, PC A02/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

When two instruments, both having replicated measurements, are used to measure the same set of items, between instrument information may be used to augment the within instrument precision estimate. A method is presented which combines the within and between instrument information to obtain an unbiased and minimum variance estimate of instrument precision. The method does not assume the instruments have equal precision.

35363 **Dynamic pressure-shear loading of materials using anisotropic crystals.** Chhabildas, L.C.; Swegle, J.W. (Sandia National Laboratories Albuquerque, New Mexico 87185). DE-AC04-DP00789. *J. Appl. Phys.;* **51**: No. 9, 4799-4807(Sep 1980).

An experimental technique is described which uses anisotropic crystals to generate dynamic pressure-shear loading in materials. The coupled longitudinal and shear motion generated upon planar impact of the anisotropic crystal can be transmitted into a specimen bonded to the rear surface of the crystal, and monitored using velocity interferometer techniques. Test results using y-cut quartz generators and x-cut quartz and y-cut quartz samples indicate that shear stresses up to 0.35 GPa can be transmitted across epoxy-bonded interfaces. The technique has been successfully used to detect a 0.2 GPa shear wave in 6061-T6 aluminum at 0.7 GPa longitudinal stress. The shear wave velocity profiles have an accuracy of +- 12%. The use of longer delay legs in the interferometer is suggested to improve the accuracy. Results obtained in this investigation are compared with numerical solutions obtained using the finite-difference wave propagation code TOODY.

35364 **Photophoretic spectrometer.** Arnold, S.; Amani, Y.; Orenstein, A. (Physics Department and Institute for Imaging Science, Polytechnic Institute of New York, Brooklyn, New York 11201). *Rev. Sci. Instrum.;* **51**: No. 9, 1202-1204(Sep 1980).

An instrument is described which measures the spectral dependence of the radiometric (photophoretic) force on a micron-sized particle in a static configuration. This spectrometer consists of a servo-stabilized Millikan chamber which can be used as a photophoretic balance over the spectral range from 200 nm to 1000 nm. Spectra may be taken in a vacuum as small as 10^{-4} torr. The action spectrum of the photophoretic force on a crystallite of CdS is used as an example. The pressure dependence of the force at 500 nm is consistant with a radiometric mechanism.

35365 **Low-drift optical-densitometer.** Karkiewicz, L.M.; Panitz, J.A.; Fowler, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Rev. Sci. Instrum.;* **51**: No. 9, 1267-1268(Sep 1980).

A general purpose, optical densitometer has been constructed using inexpensive components. A drift rate of approximately 0.3% per hour, and a measurement accuracy of 0.1%, permit the instrument to detect small changes in the optical transmission of unknown samples.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 34564

EXPLOSIONS AND EXPLOSIVES

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

35366 (LA-UR—80-2445) **Numerical study of the NOL large-scale gap test.** Bowman, A.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01.

The NOL large-scale gap test has been modeled numerically using the LASL reactive hydrodynamics code 2DE with Forest Fire burn rates. The model gives good agreement between calculated and experimental critical gap values for VTQ-2 and Composition B. The calibration of peak pressure in the gap versus gap length has been obtained from these calculations, and is in good agreement with the published experimental curve. The two-dimensional nature of the gap test is evident from the curvature of the shock wave in the gap and test sample, and from the observed distance of run to detonation in the test samples.

35367 (MHSMP—78-56) **Alternate HNS I synthesis route via the intermediate dipicrylethane.** Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Nov 1978. Contract AC04-76DP00487. 8p. NTIS, PC A02/MF A01.

A two step process for HNS synthesis consisting of the Shipp synthesis of dipicrylethane from TNT followed by the conversion of DPE to HNS by a Hungarian process was successfully demonstrated on a 50 g TNT scale. HNS yields of 60% and product purities of above 97% were obtained.

35368 (MHSMP—79-18) **Alternate HNS I synthesis route via the intermediate dipicrylethane.** Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Mar 1979. Contract AC04-76DP00487. 9p. NTIS, PC A02/MF A01.

The synthesis of HNS I has been successfully scaled to 0.5 kg quantities via an experimental two-step alternate route, wherein the intermediate, dipicrylethane, is obtained by the Shipp process and subsequently reacted to HNS I by a Hungarian procedure.

35369 (MHSMP—79-35) **Synthesis of HNS I via the intermediate dipicrylethane: 5 kg scale.** Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jun 1979. Contract AC04-76DP00487. 12p. NTIS, PC A02/MF A01.

An alternate route for the synthesis of 2,2',4,4',6,6'-hexanitrostilbene has been successfully scaled to 5 kg quantities. The intermediate dipicrylethane was synthesized via the Shipp process and was subsequently oxidized into HNS through a Hungarian process.

35370 (MLM—2764(OP)) **Stability and compatibility of TiH/sub x/KC1O$_4$ pyrotechnics.** Collins, L.W. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 9p. (CONF-801048—1). NTIS, PC A02/MF A01.

From ADPA compatibility meeting; Blacksburg, VA, USA (13 Oct 1980).

The stability and compatibility of pyrotechnic compositions are often significantly affected by variables which may not be adequately controlled during compatibility testing or production processes. The influence of several of these factors was determined for the TiH/sub x//KC1O$_4$ pyrotechnic system. The stability of KC1O$_4$ was shown to be affected by the presence of trace quantities of metal oxides, by water vapor, and by compaction. The compatibility of TiH/sub x/ fuels is related to the availability of moisture to establish an electrochemical corrosion cell. The affinity of the materials for water, necessary to establish this corrosion cell, was related to the titanium oxides which coat each particle of the powder. Several methods for controlling the influence of these variables were investigated.

35371 (MLM—2765(OP)) **Al/Cu$_2$O thermite compatibility studies by x-ray photoelectron and x-ray induced Auger spectroscopy.** Wang, P.S.; Haws, L.D.; Moddeman, W.E.; Rengan, A. (Mound Facility, Miamisburg, OH (USA); Dayton Univ., OH (USA). Research Inst.). 1980. Contract AC04-76DP00053. 12p. (CONF-801048—2). NTIS, PC A02/MF A01.

From ADPA compatibility meeting; Blacksburg, VA, USA (13 Oct 1980).

The surface chemistry of A1/Cu$_2$O thermite in powdered mixtures and in pressed pellets was studied before and after accelerated agings with x-ray photoelectron spectroscopy (XPS) and with x-ray induced Auger spectroscopy (XAES). The kinetic energies of the XPS or XAES signals were observed for A1 1s, Cu 2p/sub 1/2/, Cu 2p/sub 3/2/, Cu L_3-MM, O 1s, Al K-LL, C 1s and Cu 3s. The Al_2O_3 film thicknesses on Al metal surfaces were deduced from signal intensity ratios of Al^{+3} and Al in XPS of Al 2s and from Al K-LL XAES signals. The oxide thicknesses on Al powders from the manufacturer were measured. Mixing Al with Cu$_2$O at room temperature, to form the thermitic composition, induced oxidation of the Al and increased the oxide film thickness. Hot pressing of thermite powders at 425°C to form pellets was found to double the oxide layer. This oxide layer was found to protect the Al fuel; further aging of these pellets at 180°C for several months showed a negligi-

ble change in composition and thickness of the surface oxide. The bulk of the pellet was found to be stable and of good quality. Stearic acid, the organic additive to Al powders, was detected by the C 1s signal. The CuO impurity in Cu_2O was observed in the Cu 2p/sub 3/ 2/ signal which was broadened by unpaired electron spin-spin interaction in the $Cu^{+2}d^9$ orbital; both impurities were removed during the high temperature pressing operation.

35372 (MLM—2767(OP)) **Remote handling: blending of energetic materials.** Parks, R.L. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 18p. (CONF-801048—3). NTIS, PC A02/MF A01.

From ADPA compatibility meeting; Blacksburg, VA, USA (13 Oct 1980).

A special handling-blending room fitted with manipulators was built to provide maximum safety for operators working with energetic materials. Background experimentation and data upon which the design was based, and the design of the room are discussed and illustrated.

35373 (MLM—2769(DP)) **Nickel-iron alloy corrosion in a sealed pyrotechnic system.** Tibbitts, E.E.; Salerno, R.F. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 15p. (CONF-801048—4). NTIS, PC A02/MF A01.

From ADPA compatibility meeting; Blacksburg, VA, USA (13 Oct 1980).

Actuators loaded with Ti/$KClO_4$ and aged for several days had chlorine-containing corrosion products on Alloy-52 electrode pins and Tophet-C bridgewire surfaces. An in-depth analysis of these materials indicated that moisture, organic contamination, and chlorine were the major causes of the corrosion. Definite evidence was uncovered that indicated a partial decomposition of the $KClO_4$ was the major source of the chlorine. In the presence of moisture, particles that settle on the metal surface cause the formation of galvanic or oxygen concentration cells that dissolve to produce electrolytes on the metal surface causing corrosion of the metal.

35374 (SAND—79-0020) **Frank-Kamenetskii problem revisited. Part II: gradient boundary conditions.** Gill, W.; Shouman, A.R.; Donaldson, A.B. (Sandia National Labs., Livermore, CA (USA); New Mexico State Univ., Las Cruces (USA)). Aug 1980. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01.

This report extends the analysis of the thermal explosion problem posed by Frank-Kamenetskii (Part I) to include the gradient boundary conditions. Cooling boundary conditions cause ignition when the steady state solutions occur within the unstable region. We found that a three-dimensional plot of characteristic parameters for the heating boundary conditions forms an unstable region that defines the critical conditions. The symmetrical temperature boundary condition previously studied is shown to be only a special case of the heating problem. By applying the midpoint approximation, we can obtain the analytical expressions of the critical ignition states and then compare them with the results of a numerical solution of the nonapproximated problem. The conclusions of the analysis agree qualitatively with the experiment.

35375 (SAND—80-0965c) **Stability and compatibility studies with the inorganic explosive 2-(5-cyanotetrazolato)pentaamminecobalt(III) perchlorate (CP).** Massis, T.M.; Morenus, P.K.; Huskisson, D.H.; Merrill, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 28p. (CONF-801048—5). NTIS, PC A03/MF A01.

From ADPA compatibility meeting; Blacksburg, VA, USA (13 Oct 1980).

2-(5-Cyanotetrazolato)pentaamminecobalt(III) perchlorate (CP) is an inorganic secondary explosive that has been developed for applications involving deflagration-to-detonation transition. Previously the primary explosives lead azide and lead styphnate had been used. Stability and compatibility studies with CP have been conducted for periods up to three years. By using the rate of formation of cobalt(II) as the prime stability measurement for CP no reaction above baseline has been observed at temperatures at or below 80°C. At 120°C, approximately 2.2% reaction has been measured after three years with the concentration approaching a constant value. With the typical materials of construction in low voltage detonators, no compatibility problems with CP have been found. Adhesives such as epoxies have also shown good compatibility characteristics with CP. The only material tested thus far that exhibits potential compatibility problems with CP has been copper.

35376 (UCRL—52941) **Organic Materials Division research bulletin.** Clements, J. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1980. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01.

This document is a compilation of brief summaries of current research. The topics are in four main areas: (1) formulation and studies of the behavior and properties of high explosives; (2) development and design of fiber-reinforced composites for flywheels and pressure vessels; (3) development and evaluation of polymeric structural materials, adhesives, lubricants, and sealants; and (4) research in physical chemistry.

35377 **Short-duration shock-wave initiation of solid explosives.** Ramsay, J.B. (Los Alamos Scientific Lab., NM). *Acta Astronaut.;* **6**: 771-783(1979).

In the study of the initiation of solid, polycrystalline explosives by short-duration (thin) shock waves, several investigators have found that the relationship between initial pressure (P) and shock duration (tau) can be described with the equation P^2 tau = const. Different mechanisms have been proposed to explain this relationship. However, the possibility that the relationship arises from the hydrodynamics of the overtake of the shock wave by a rarefaction from the rear has not been considered. Five simple models, three analytic and two numerical models have been investigated to examine the relationship between the entry time of the rarefaction and the time of its overtaking the initiating shock wave in a solid explosive. What effects changes in the wave profile and sustained-shock parameters have on the interaction of the rarefaction and the shock front are explored. One of the analytic models fits the experimental data for the explosive PBX 9404 exceptionally well, but the very simplicity of the analytic model argues that transit time data on fixed-length samples are not sufficient to verify a proposed model for the initiation of solid explosives by thin shock waves. They analytic models show, in a simple manner, how the sustained-shock initiation parameters can influence the thin-shock initiation. The two numerical models, neither of which are intended to model reality, could be forced to fit the experimental sustained- and thin-shock data. They also illustrate some of the additional data that will be required before a realistic model can be developed. Given a more realistic model for the hydrodynamic conditions behind the shock front, the study indicates that a model based on rarefaction overtake is apparently adequate to describe thin-shock initiation.

NUCLEAR

35378 (AD-A—078542/8) **Operation Sandstone nuclear explosions. atomic weapons tests. Operation Sandstone. Annex I part III. Volume I. Report to joint chiefs of staff. Sandstone report no. 4.** (Joint Task Force Seven, Washington, DC (USA)). 1948. 443p. NTIS, PC AA19/MF A01.

The following topica are discussed: communications and electronics; meteorology; adjutant general, Hq JTF-7; medical; fiscal; engineer; transportation; and photography.

35379 (AD-A—078554/3) **Operation Sandstone, nuclear explosions. scientific director's report of atomic weapon tests. Annex 10. radiological safety instruments. Sandstone report no. 31.** (Joint Task Force Seven, Washington, DC (USA)). 1948. 145p. NTIS, PC AA07/MF A01.

Task Group 7.6, with assigned responsibilities for radiological health protection during Operation Sandstone, conducted certain tests and made observations on field performance of a number of miscellaneous instruments including Geiger-Mueller survey instruments, ionization chamber survey instruments, and integrating dosimeters. This report contains observations on the numbers and types of instruments required for operations of a similar nature to Operation Sandstone. Certain design defects are noted in the instruments used, and some corrective recommendations are made. In general, the performance of the instruments used during the operation was good. Serious leakage problems were encountered with pocket dosimeters. Some troubles were encountered in the use of instruments in aircraft. Information is given in Appendix B on the processing of film badges used for health protection.

WEAPONRY

REFER ALSO TO CITATION(S) 35785, 35786

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 35388, 35666

35380 (COO—1340-74) **Role of the Qinghai-Xizang plateau in feedback mechanisms affecting the planetary circulation.** Reiter, E.R.; Yi-Hui, D. (Colorado State Univ., Fort Collins (USA). Dept. of

Atmospheric Science). 1980. Contract AS02-76EV01340. 59p. NTIS, PC A04/MF A01.

It has been recognized for some time that the Qinghai-Xizang plateau is of great importance in generating planetary long-waves which, in resonance with similar waves induced by the Rocky Mountains, lead to the familiar pattern of quasi-stationary Rossby waves observed on monthly-mean upper level pressure charts. Seasonal forcing of flow patterns also appears to be particularly strong in the Qinghai-Xizang plateau region. Recent investigations suggest that the Qinghai-Xizang plateau may also be involved in feedback mechanisms which control in an important way the interannual variability of the general circulation of the atmosphere. It appears that the effects of the Qinghai-Xizang plateau on the interannual variability of the atmospheric circulation over Asia are but one important manifestation of a network of feedback mechanisms, ranging from the El Nino problems along the Peruvian coast to droughts in the Sahel region. A better understanding of each of the mechanisms involved will lead us closer to successful long-range forecasting of some of the weather phenomena which have a considerable effect on local and regional economics.

35381 (DOE/EV/01340—T3) **Parametrization of net radiation at the surface using data from the Wangara experiment.** Edson, R.T. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). Sum 1980. Contract AS02-76EV01340. 99p. NTIS, PC A05/MF A01.

Thesis.

Hourly Wangara boundary layer data (Clark et al., 1971) was used to substantiate previously derived empirical equations of the surface radiation budget. These equations only require measurements taken by a surface observer in order to be evaluated. A parameterization was made for infrared (IR) radiation. From this procedure, a residual radiation was obtained from the measured daytime net radiation data in order to approximate short wave (SW) radiation. Diurnal trends in radiation and other related meteorological parameters were also evaluated. For IR radiation, the Brunt equation was found to adequately represent effective radiation without clouds. IR attenuation (K-values) of 0.89, 0.64, and 0.51 were calculated for low, middle, and high clouds, respectively. A modification of Beer's Law was derived to evaluate the residual radiation under clear skies as suggested by Flowers et al. (1969) for SW radiation. With the surface albedo assumed at 0.15, a mean turbidity coefficient of 0.16 was determined. Also, the square root of the optical air mass was found to best represent the data in this equation. An analysis of SW cloud attenuation coefficients (C-values) from the residual radiation proved inconclusive. Of considerable importance is the finding that cloud attenuation of the residual radiation behaved nonlinearly. Whereas solutions as high as the fourth order fit the data at noon, quadratic solutions fit well near sunset and sunrise. Overall; relative deviations during the day of the combined parameterization were approximately 20% at noon and just less than 30% for periods up to one hour before sunset or sunrise. Predictions within these one-hour periods, however, contained considerable error, partially due, to the scatter and small magnitude of the measurements. Diurnal trends in surface radiation and other meteorological parameters were established.

35382 (LMF—69, pp 18-23) **Generation and characterization of actinide oxide aerosols of specific physicochemical forms.** Kanapilly, G.M.; Mo, T.; Brodbeck, R.D. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Pure and mixed U and Pu oxide aerosols were crystalline, uniformly dense and of specific physicochemical form. Mixed (U-Pu)O_2 aerosols were produced as solid solutions with different ratios of U/Pu. These aerosols were prepared by heat treatment at 1150°C; a temperature most often used to prepare other actinide oxide aerosols at our laboratory.

35383 (ORNL/TM—7351) **Geoecology: a county-level environmental data base for the conterminous United States.** Olson, R.J.; Emerson, C.J.; Nungesser, M.K. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 312p. (ESD—1537). NTIS, PC A14/MF A01.

The Geoecology Data Base represents a unique compilation of computerized environmental data for research and development needs. Environmental assessment and planning for energy development require rapid access to data at appropriate spatial and temporal scales. In the Environmental Sciences Division (ESD) at Oak Ridge National Laboratory (ORNL), we have developed an integrated data base of diverse environmental resource information from extant sources. Data are stored at the county level of resolution for the conterminous United States with some data available for subcounty units within larger, more diverse eastern counties. The Geoecology Data Base contains selected data on terrain and soils, water resources, forestry, vegetation, agriculture, land use, wildlife, air quality, climate, natural areas, and endangered species. Basic files on human population are also included to complement the environmental files. Data are stored in metric-SI units. The Geoecology Data Base is currently fulfilling diverse ongoing research needs while it is being expanded and updated as needs and new data are identified. This report is both a documentation and a user's guide to the Geoecology Data Base. It describes the Data Base design, illustrates applications, provides examples of accessing the Data Base, and gives general information on the data set contents.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 34467, 34469, 34490, 34506, 35228, 35491, 35585, 35589, 35611, 35644, 35645, 35648

35384 (ANL/EES-TM—90(Vol.3)) **In pursuit of clean air: a data book of problems and strategies at the state level. Volume 3: Federal Regions IV and VI.** Garvey, D.B.; Streets, D.G. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 338p. NTIS, PC A15/MF A01.

This is the third volume of a five-volume report, designed to provide useful information for policy analysis in the Department of Energy, especially for the examination of possible areas of conflict between the implementation of a national energy policy calling for the increased use of coal and the pursuit of clean air. Information is presented for each state in Federal Regions IV and VI under the following section headings: state title page (includes a summary of air quality data); revised state implementation plan outline; maps of nonattainment areas, as designated; Storage and Retrieval of Aerometric Data (SAROAD); SAROAD data maps; power plant data; power plant maps; and county maps. States in Federal Region IV include: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. Those in Federal Region VI include: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. (JGB)

35385 (ANL/EES-TM—90(Vol.4)) **In pursuit of clean air: a data book of problems and strategies at the state level. Volume 4. Federal Regions V and VII.** Garvey, D.B.; Streets, D.G. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 280p. NTIS, PC A13/MF A01.

The following material is provided for each state in Federal Regions V and VII: state title page lists nonattainment areas for each pollutant, the number of monitors with valid readings for a particular averaging time for a pollutant, and the number of monitors that recorded a violation of the standard); revised State Implementation Plan (SIP) outline (covers sources of the problems, the proposed strategies for achieving attainment, and new state review procedures); maps of nonattainment areas, as designated; SAROAD (Storage and Retrieval of Aerometric Data) data; SAROAD data maps; power plant data; power plant maps; and county maps. States in Federal Region V are Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Federal Region VII includes Iowa, Kansas, Missouri, and Nebraska. (JGB)

35386 (ANL/EES-TM—90(Vol.5)) **In pursuit of clean air: a data book of problems and strategies at the state level. Volume 5. Federal Regions VIII, IX, and X.** Garvey, D.B.; Streets, D.G. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 269p. NTIS, PC A12/MF A01.

The following material is provided for each state in Federal Regions VIII, IX, and X: state title page (lists nonattainment areas for each pollutant, the number of monitors with valid readings for a particular averaging time for a pollutant, and the number of monitors that recorded a violation of the standard); revised State Implementation Plan (SIP) outline (covers sources of the problems, the proposed strategies for achieving attainment, and new state review procedures); maps of nonattainment areas, as designated; SAROAD (Storage and Retrieval of Aerometric Data) data; SAROAD data maps; power plant data; power plant maps; and county maps. States in Federal Region VIII are Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. Federal Region IX includes Arizona, California, and Nevada. Federal Region X includes Idaho, Oregon, and Washington. (JGB)

35387 (DOE/EV—0094) **Carbon dioxide effects research and assessment program. A comprehensive plan. Part I. The global carbon cycle and climatic effects of increasing carbon dioxide.** (Department of Energy, Washington, DC (USA). Office of Health and Environmental Research). Aug 1980. 97p. NTIS, PC A05/MF A01.

Initial plans for research of the carbon dioxide (CO_2) and climate issue were prepared in 1978 and were reviewed extensively at that time by federal agencies and members of the scientific community. Since then the plans have been used to guide early phases of the Department of Energy's and the nation's efforts related to this issue. This document represents a revision of the 1978 plan to (a) reflect recent ideas and strategies for carbon cycle research, and (b) expand the scope of research on climatic responses to increasing atmospheric concentrations of CO_2. The revised plan takes into account a number of investigations already being supported by

various agencies, and it attempts to build on or add to existing research where there is a crucial need for information directly related to the CO_2 issue. It should be recognized that this document is the first section of a comprehensive plan on the overall consequences of increasing concentrations of CO_2, and includes guidelines for research on the Global Carbon Cycle and Climatic Effects of Increasing CO_2.

35388 (DOE/EV/01340—T2) **Planetary-wave behavior and arctic air pollution.** Reiter, E.R. (Colorado State Univ., Fort Collins (USA)). 1979. Contract AS02-76EV01340. 154p. NTIS, PC A08/MF A01.

An attempt was made to relate episodes of air pollution at Barrow, Alaska, containing vanadium, to the behavior of planetary waves in middle and high latitudes. A stationarity index for planetary waves is defined as the ratio between amplitudes computed from monthly mean maps and the mean amplitudes computed on a daily basis and averaged over the same month, irrespective of phase angle. Longitude-time sections of 500-mb height anomalies at various latitudes are related to vanadium pollution episodes at Barrow.

35389 (DOE/EV/10022—T1) **Progress report for the US Department of Energy, December 1, 1978-October 31, 1979.** (Hamburg Univ. (Germany, F.R.). SCOPE/UNEP International Carbon Unit). 26 Oct 1979. Contract AC02-79EV10022. 127p. NTIS, PC A07/MF A01.

This progress report presents papers dealing with the distribution of dissolved and particulate carbon in the oceans as it relates to the global carbon cycle. Also presented are papers concerning global climate and its relationship with carbon dioxide levels in the atmosphere. Items within the scope of EDB are entered individually. (ACR)

35390 (DOE/EV/13573—T1, pp Paper 5, 8 pages) **Determination of ^7Be/ozone ratios in the stratosphere.** Husain, L.; Rusheed, A.; Dutkiewicz, V. (New York State Department of Health, Albany). 1979.

From Natural radioactive isotopes of beryllium in the environment; Yale Univ., CT, USA (1-2 October 1979).

The use of ^7Be concentrations measured at ground level with stratospheric $^7Be/O_3$ ratios provides a technique for determining the stratospheric ozone contributions to the troposphere. Calculations suggest that the stratosphere is the primary source of tropospheric ozone in both hemisphere. Furthermore, the stratospheric -tropospheric exchange rate in the northern hemisphere is two to three times that in the southern hemisphere.

35391 (LMF—69, pp 207-210) **Extraction and fractionation of organics from diesel exhaust particles.** Royer, R.E.; Sturm, J.C.; Walter, R.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

There are numerous options available for methods of extracting and fractionating organic compounds from diesel exhaust particles. It appears that ultrasonic extraction with dichloromethane and fractionation by gel chromatography are, overall, the methods of choice.

35392 (LMF—69, pp 277-280) **Aerosol characteristics of fly ash from fluidized bed combustion of Paraho oil shale.** Newton, G.J.; Barr, E.B.; Carpenter, R.L.; Hanson, R.L.; Weissman, S.H. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Results of physical and chemical characterization of aerosols formed in fluidized bed combustion (FBC) of Paraho oil shale are reported. Paraho oil shale was burned in the Morgantown Energy Technology Center's experimental 18-inch (internal diameter) atmospheric pressure, fluidized bed combustor. Airborne samples were obtained from the effluent stream using filters, cascade impactors and a vapor-phase organic trap containing Tenax. Aerosol sizes ranged from 2.4 to 5.5 μm mass median aerodynamic diameter with mass loadings ranging from 0.8 to 6.6 g/m^3, depending on sampling position at the FBC. Vapor-phase organic concentration as determined by gas chromatography of Tenax extracts was 1.5 +- 1.4 mg/m^3 and the extractable, particle-associated organic concentration was 0.18 +- 0.13 mg/m^3 in stack ash samples.

35393 (LMF—69, pp 281-285) **Organic characterization of effluents from the fluidized bed combustion of coal and oil shale.** Hanson, R.L.; Carpenter, R.L.; Clark, C.R.; Brooks, A.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The use of gas chromatography/mass spectrometry (GC/MS) to tentatively identify major components in dichloromethane extracts of effluent particles from fluidized bed combustion (FBC) is described. Several reported mutagens were detected in the extracts that were found to be positive in the Salmonella mutagenicity assay.

35394 (LMF—69, pp 286-293) **Effect of fuel type on elemental composition of fluidized bed combustor ash.** Weissman, S.H.; Carpenter, R.L.; Newton, G.J. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This report describes elemental constituents in the exhaust stream of an experimental, atmospheric pressure, fluidized bed combustor (FBC). Particles were collected and analyzed using spark source mass spectrometry and atomic absorption spectroscopy. The FBC ash was similar to conventional pulverized coal combustor ash in minor and toxic trace elemental composition. There was considerable variation in elemental content with fuel type.

35395 (LMF—69, pp 294-297) **Composition of FBC aerosol particles as function of their aerodynamic size.** DeNee, P.B.; Gottlieb, R.A.; Carpenter, R.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Aerosol samples were collected from the stack breech of an experimental fluidized bed coal combustion plant. A Lovelace aerosol particle separator (LAPS) was used to separate particles along a metallic foil according to their aerodynamic diameter. The particles were collected directly on carbon coated copper electron microscope grids placed at four positions along the foil corresponding to aerodynamic diameters of 2.7, 1.7, 1.2 and 0.7 μm. Up to 50 particles of each diameter were photographed and analyzed using a scanning electron microscope and X-ray analyzer. Nine elements were selected for analysis (Mg, Al, Si, P, S, K, Ca, Ti and Fe) because they represent the most common inorganic elements in the parent fuel (coal) and bed material (limestone). The preliminary results indicated that calcium, aluminum and silicon were the three largest components of the majority of the particles in all four size ranges. Although sulfur was seen in some of the calcium containing particles, it was not seen in all the particles. There was considerable variation in the composition of the particles within the same size range.

35396 (LMF—69, pp 298-302) **Coal combustion fly ash characterization: stack residence times, exit temperatures and Reynolds numbers.** Rothenberg, S.J.; Cheng, Y.S.; Newton, G.J.; Carpenter, R.L.; Hanson, R.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The potential toxicity of fly ash effluents from power plants depends in part on the nature of the material on the surface of the ash. To model the processes which determine the nature of the material on the ash surface, one must know the stack residence time of the ash, the temperature at which the ash exits the stack and the flow Reynolds number. Data from over 50 power plant units, located in EPA Region 8, USA, were examined to obtain the range, mean and variance of stack residence times, exit temperatures and flow Reynolds numbers of stack effluents. Data from subsets of stations, classified by age and plant capacities, were also tabulated. Residence times were compared with measured adsorption half-times to show that the quantity and type of hydrocarbons that may be adsorbed on ash in the stack of a modern plant is probably primarily determined by kinetics and includes both low and high molecular weight compounds. In contrast, in older plants, with higher stack exit temperatures, equilibria probably limit adsorption to high molecular weight hydrocarbons. Since thermal relaxation times are short compared with stack residence times, thermal segregation is probably only important for large particles ($d > 100$ μm).

35397 (LMF—69, pp 303-311) **Summary of physical and chemical characterization of a low Btu coal gasifier.** Newton, G.J.; Carpenter, R.L.; Weissman, S.H.; Hanson, R.L.; Hobbs, C.H.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Results of physical and chemical characterization of process streams at the Morgantown Energy Technology Center's stirred-bed, Lurgi-type, low-Btu coal gasifier are summarized. Data are derived from samples obtained from five separate field sampling efforts. Aerosol, liquid and solid process streams were analyzed for physical and chemical characteristics relevant to the inhalation hazard assessment.

35398 (LMF—69, pp 359-365) **Coal combustion fly ash characterization: ESCA, EDXA and scanning electron microscopy.** Rothenberg, S.J.; DeNee, P.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The surface and bulk properties of five samples of fly ash taken from three different types of combustors have been examined using Electron Spectroscopy for Chemical Analysis (ESCA), Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Analysis (EDXA). Silicon, aluminum, magnesium, calcium, iron, potassium and sulphur were detected in all samples by both ESCA and EDXA, carbon and oxygen by ESCA, titanium by EDXA. Energy Dispersive X-ray Analysis data for individual particles ex-

hibited marked particle-to-particle compositional variation. Comparison of ESCA data obtained before and after ion sputtering, and of ESCA and EDXA data demonstrate that carbon, sulfur, sodium, calcium, iron and magnesium are surface enriched while silicon, potassium and chlorine are surface depleted.

35399 (PB—80-105836) **Flooded-bed scrubber for machine-mounted coal mine applications. Open file report (final).** Grigal, D.J.; McAndrew, W.J. (Donaldson Co., Inc., Minneapolis, MN (USA)). May 1979. Contract J0188098. 42p. NTIS, PC A03/MF A01.

The objective of the research was to monitor operating conditions of four flooded, fibrous-bed filter panels used during normal underground mining operation and to analyze clogging and structural problems. After observing structural and clogging problems and conducting laboratory and field tests, a final flooded, fibrous-bed filter design that minimizes clogging and structural problems was recommended to the Bureau of Mines. This report also describes the dust sampling procedures used to determine the dust concentration at the flooded, fibrous-bed scrubber intake duct.

35400 (PB—80-108384) **Acid rain research summary.** Schaefer, M. (Environmental Protection Agency, Washington, DC (USA)). Oct 1979. 28p. NTIS, PC A03/MF A01.

This brochure briefly summarizes the EPA's acid rain research program in an easily read, non-technical format.

35401 (PB—80-108962) **Setting priorities for control of fugitive particulate emissions from open sources. Final report, September 1977-May 1979.** Cooper, D.W.; Sullivan, J.S.; Quinn, M.; Antonelli, R.C.; Schneider, M. (Harvard Univ., Boston, MA (USA). School of Public Health). Aug 1979. 136p. NTIS, PC A07/MF A01.

The report describes setting priorities for controlling fugitive particulate emissions. Emission rate estimates of suspended particulates from open sources in the US were obtained from emission factors and source extents in the literature. Major open sources, with their estimated total emission rates (in millions of tons per year), are: unpaved roads, 300; construction activities, 30; wind erosion of cropland, 40; paved roads, 8; and wildfires, agricultural tilling, and mineral extraction, each 3. (For comparison, point sources of particulates in the US are estimated to emit about 20 million tons per year). Open source emissions are estimated for each state. Most open source rates are correlated with each other and state population is strongly correlated with the total rate and with most of the source types. The use of cost effectiveness is compared. Paving unpaved roads should reduce emissions at an average of less than $0.01/lb for such states as RI and DE (for rural roads) and AK, AZ, CA, DE, MI, NV, PA, CO, FL, IL, IN, KY, MD, MA, NJ, NM, OH, RI, TN, TX, UT, VA, WA, and WV (for remaining unpaved municipal roads). The control of unpaved road emissions (generally by paving), especially in cities, and the control of emissions from construction activities are concluded to deserve high priority in the effort to reduce total suspended particulate levels.

35402 (PB—80-108988) **Demonstration of nonpoint pollution abatement through improved street cleaning practices. Final report, 1976-1978.** Pitt, R. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Aug 1979. 292p. NTIS, PC A13/MF A01.

A presentation is given of the results and conclusions from the EPA-sponsored demonstration study of nonpoint pollution abatement through improved street cleaning practices. An important aspect was the development of sampling procedures to test street cleaning equipment performance in real-world conditions. Other areas explored in this study include: (1) accumulation rate characteristics of the various pollutants associated with street dirt; (2) runoff flow characteristics, concentrations and total mass yields of monitored pollutants in runoff, and street dirt removal capabilities and effects on deposition in the sewerage for various kinds of storms; (3) costs and labor effectiveness of street cleaning, runoff treatment, and combined runoff and wastewater treatment; and (4) results of a special study of airborne dust losses from street surfaces.

35403 (PB—80-109010) **Air pollution emissions inventory systems.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Oct 1978. 65p. NTIS, PC A04/MF A01.

This report describes how an emissions inventory system should be organized and operated.

35404 (PB—80-109028) **Air pollution: assessment methodology and modelling. Current needs and uses of quality models.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). May 1979. 68p. NTIS, PC A04/MF A01.

This study describes the uses and needs for air quality models.

35405 (PB—80-109036) **Air pollution: assessment methodology and modelling. Fundamentals for the application of a Gaussian plume model.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Apr 1979. 56p. NTIS, PC A04/MF A01.

This study describes the fundamentals for the application of a Gaussian plume model.

35406 (PB—80-109127) **Oxidant-precursor relationships under pollutant transport conditions: outdoor smog chamber study. Volume I. Final report, June 1975-June 1978.** Sickles, J.E.; Ripperton, L.A.; Eaton, W.C.; Wright, R.S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1979. Contract EPA-68-02-2207. 125p. NTIS, PC A06/MF A01.

Multiple-day experiments were conducted in outdoor smog chambers to investigate the influence of simulated transport on ozone generation by various combinations of a surrogate urban hydrocarbon mixture and nitrogen oxides. The simulation of transport was accomplished by progressively diluting the contents of the chambers with purified air. First day ozone maximum concentrations were reduced under dilution conditions and were sensitive to both dilution rate and time at which dilution was initiated. Second and third-day ozone maxima were reduced at increasing dilution rates, but the reduction was less than proportional to the extent of dilution. The ozone-generative potential of an aged photochemical system generally exceeded 0.08 ppM. Additional experiments were conducted to examine the ozone-generative potential of low reactivity hydrocarbons, to provide data for testing and validation of a computer-based photochemical simulation model, and to compare the behavior of two types of outdoor smog chambers. Volume 1 contains all textual material.

35407 (PB—80-109135) **Oxidant-precursor relationships under pollutant transport conditions: outdoor smog chamber study. Volume II. Appendixes. Final report, June 1975-June 1978.** Sickles, J.E.; Ripperton, L.A.; Eaton, W.C.; Wright, R.S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1979. Contract EPA-68-02-2207. 435p. NTIS, PC A19/MF A01.

Multiple-day experiments were conducted in outdoor smog chambers to investigate the influence of simulated transport on ozone generation by various combinations of a surrogate urban hydrocarbon mixture and nitrogen oxides. The simulation of transport was accomplished by progressively diluting the contents of the chambers with purified air. First day ozone maximum concentrations were reduced under dilution conditions and were sensitive to both dilution rate and time at which dilution was initiated. Second and third-day ozone maxima were reduced at increasing dilution rates, but the reduction was less than proportional to the extent of dilution. The ozone-generative potential of an aged photochemical system generally exceeded 0.08 ppm. Additional experiments were conducted to examine the ozone-generative potential of low reactivity hydrocarbons, to provide data for testing and validation of a computer-based photochemical simulation model, and to compare the behavior of two types of outdoor smog chambers. Volume 2 contains all the smog chamber analytical data for hydrocarbons, NO, O3, CO, CH2O, and condensation nuclei, as well as dilution and meteorological data.

35408 (PB—80-109176) **ELSTAR photochemical air quality simulation model. Model-simulation.** Lurmann, F.; Godden, D. (Coordinating Research Council, Inc., Atlanta, GA (USA)). 4 Sep 1979. vp, mag tapep. Source tape is in ASCII character set. Character set restricts preparation to 9 track one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB80-109184.

This tape contains the ELSTAR photochemical air quality simulation model Fortran source code and a sample problem data set for Los Angeles, California (1973). The ELSTAR model consists of a series of computer programs used to predict atmospheric concentrations of photochemical pollutants such as ozone, nitrogen dioxide and sulfate in urban regions. The model includes the effects of meteorological transport, turbulent eddy diffusion, source emissions and chemical kinetic reactions...Software Description: The program is written in the Fortran programming language for implementation on a Data General NOVA 3 using the 6021 operating system. 230 K bytes of core storage are required to operate the system.

35409 (PB—80-109184) **User's guide to the ELSTAR photochemical air quality simulation model. Report for April 1978-June 1979.** Lurmann, F. (Environmental Research and Technology, Inc., Westlake Village, CA (USA)). Sep 1979. 506p. NTIS, PC A22/MF A01.

This manual is intended for users of Environmental Research and Technology, Inc.'s ELSTAR photochemical air quality simulation model. The ELSTAR model consists of a series of computer programs used to predict atmospheric concentrations of photochemical pollutants such as ozone, nitrogen dioxide and sulfates in a Lagrangian reference frame. The model includes the effects of meteorological transport, turbulent eddy diffusion, source emissions and chemical kinetic reactions. This manual describes the general structure and operational capabilities of the ELSTAR model. De-

tailed instructions are provided for input data specification and code operation to assist prospective users of the model.

35410 (PB—80-109978) **Guidelines to air quality management systems.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Apr 1979. 167p. NTIS, PC A08/MF A01.

This guideline document and its appendices may assist countries with current and projected air pollution problems in developing a systematic and effective Air Quality Management System (AQMS). It is addressed to national, regional and local authorities concerned with the establishment and operation of an AQMS. The document gives an overview of several AQMS and the applied practice in NATO countries. It describes the AQMS building blocks - assessment, standards and criteria, strategy plans - as well as the technical and economical requirements and their legal and administrative implications. Emphasis is put on the formulations of strategy plans. Major strategy plan options, criteria for the selection of control strategies, surveillance technique, possible interactions with other environmental media, and, the necessity for revision of strategy plans, are described.

35411 (PB—80-110331) **Air pollution pilot study on assessment methodology and modeling. Final report.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Oct 1979. 42p. NTIS, PC A03/MF A01.

This study recommends that nations find solutions for their air pollution problems through cooperative effort.

35412 (PB—80-110976) **Fugitive emissions from iron foundries. Final report, June 1975-February 1978.** Wallace, D.; Cowherd, C. Jr. (Midwest Research Inst., Kansas City, MO (USA)). Aug 1979. Contract EPA-68-02-2120. 113p. NTIS, PC A06/MF A01.

The report describes the assessment of fugitive emissions of air pollutants discharged from process operations in iron foundries, and the need for the development of control technology for the most critical sources. Data indicates that the most significant fugitive emissions control problem in foundries is the pouring of hot metal into sand molds and the subsequent cooling of castings of these molds. Other significant fugitive emissions sources which have control problems are the electric arc furnace, preparation of molds and cores using organic binders, and casting shakeout. These conclusions are tempered by the fact that, for most fugitive emission sources in iron foundries, data is insufficient to determine accurate emission factors. Research and development programs are recommended: to better quantify the most significant sources; to evaluate currently available control technology for electric arc furnaces and shakeout; and to develop new control technology for pouring and cooling and for core and mold preparation using organic binders.

35413 (PB—80-111495) **Study of winter air pollutants at Fairbanks, Alaska. Final report, 1976-1979.** Coutts, H.J. (Corvallis Environmental Research Lab., College, AK (USA). Arctic Environmental Research Station). Sep 1979. 72p. NTIS, PC A04/MF A01.

An air pollution monitoring program was initiated by the Arctic Environmental Research Station (AERS). Ambient monitoring was done throughout the winters of 1976-1977 and 1977-1978 at the Fairbanks Post Office and on the AERS roof. Indoor-outdoor monitoring was done at the new State Building during January 1979. Pollutants measured were nitric oxide, nitrogen dioxide, ozone, sulfur dioxide, total suspended particulates, sulfate, nitrate, lead, and carbon monoxide. High values, compared to those measured in the contiguous states, were found for NO and Pb. The health effects of the measured levels of NO are not known, but Pb levels exceeded EPA standards. More monitoring for Pb is needed and, if the high concentrations are found to be area wide, then local authorities may want to consider restrictions on use of leaded gasoline during the winter months.

35414 (PB—80-111552) **Microscale variations in ambient concentrations of pollutants in St. Louis air. Final report, 1974-1977.** Chaney, L.W. (Michigan Univ., Ann Arbor (USA)). Sep 1979. 64p. NTIS, PC A04/MF A01.

As part of the Regional Air Pollution Study, a series of studies were carried out in St. Louis during the summers of 1974, 1975, and 1976 primarily to determine the subgrid concentrations of ambient air pollution. One primary pollutant gas, CO, and one secondary pollutant gas, ozone, were chosen to be representative. The methodology for determining subgrid concentration variations of these gases is discussed. Portable monitors and the collection and analysis of bag samples were used to determine pollutant concentrations. In some cases the monitors were moved along selected paths while the measurements were made; in other cases the monitors were placed at selected subgrid locations. The data were collected at six sites during the first year, and at two sites during the final two years. Both urban and rural sites were selected. All the data were collected during daylight hours, generally between 10:00 a.m. and 4:00 p.m.

35415 (PB—80-111784) **Air pollution. Appendix C (revised). Assessment of air quality in Frankfurt, Federal Republic of Germany.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Dec 1977. 167p. NTIS, PC A08.

This report presents the results of a study of air quality and meteorological parameters in the vicinity of Frankfurt, West Germany. Implications for air quality monitoring and regional planning in other industrial areas are discussed.

35416 (PB—80-111818) **Analysis of thermal decomposition products of flue gas conditioning agents. Final report, January 1977-March 1979.** Spafford, R.B.; Dismukes, E.B.; Dillon, H.K. (Southern Research Inst., Birmingham, AL (USA)). Aug 1979. Contract EPA-68-02-2200. 117p. NTIS, PC A06/MF A01.

The report gives results of a study of reactions of several flue gas conditioning agents in a laboratory-scale facility simulating conditions in the flue gas train of a coal-burning power plant. Primary purposes of the study were to characterize the chemical species resulting from adding conditioning agents to flue gas and to identify potentially hazardous chemical species originating from the agents that may be emitted into the environment. The compounds investigated were sulfur trioxide, ammonia, triethylamine, sodium carbonate, ammonium sulfate, and diammonium hydrogen phosphate. The predominant types of reactions observed in these experiments were thermal decomposition at high temperatures, recombination of decomposition fragments at lower temperatures, and reactions with normal components of the flue gas. The only significant environmental threat of any product identified during this study was the formation of N-nitrosodiethylamine as the result of injecting triethylamine into the flue gas. This potent carcinogen was found in trace amounts when triethylamine was injected at 160C.

35417 (PB—80-111966) **Measurement of polycyclic organic matter for environmental assessment. Final report, December 1976-March 1979.** Levins, P.L.; Reichsteiner, C.E. Jr.; Stauffer, J.L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1979. Contract EPA-68-02-2150. 75p. NTIS, PC A04/MF A01.

The report discusses methods of measuring polycyclic organic matter (POM) for environmental assessment. It describes two fluorescence methods of estimating total POM levels in samples. Either method may be used to screen samples for further specific analyses. It also describes three gas chromatography/mass spectrometry (GC/MS) methods for measuring specific POM compounds. The use of liquid crystal chromatographic phases is recommended for measuring a few POMs; e.g., specifically for benzo(a)pyrene. It discusses GC/MS methods for a wide range of POMs for both capillary and packed GC columns. The three methods for specific POM identification have been verified with collected environmental samples for different kinds.

35418 (PB—80-112014) **Basic studies of flow and diffusion over hills. Final report, 1 September 1976-31 August 1977.** Arya, S.P.S.; Hunt, J.C.R. (North Carolina State Univ., Raleigh (USA). Dept. of Geosciences). Sep 1979. 39p. NTIS, PC A03/MF A01.

This research program was initiated with the overall objectives of gaining a better understanding of flow and diffusion of pollutants in complex terrain under both neutral and stably stratified conditions, providing a sound data base for testing existing theories, and developing new theories of flow and diffusion around isolated hills and ridges. To this end, experiments were conducted with models of a bell shaped hill and a 2-D steep ridge in EPA's meteorological wind tunnel and salt-water stratified towing tanks. Measurements were made of the flow structure, as well as the concentration patterns around the hills due to point sources located at different heights and positions relative to the hills.

35419 (PB—80-112303) **Quality assurance handbook for air pollution measurement systems. Volume III. Stationary source specific methods.** von Lehmden, D.J.; DeWees, W.G.; Nelson, C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab.). May 1979. Contract EPA-68-02-2725. 404p. Environmental Monitoring and Support Lab., Research Triangle Park, NC. Quality Assurance Branch.

This Handbook includes quality assurance guidelines on stationary source emission measurements. Regardless of the scope and magnitude of the stationary source emission measurement program, there are a number of common considerations pertinent to the production of quality data. These common parameters are discussed in Section 3.0 of Volume III and include quality assurance guidelines in the areas of: (1) planning the test program; (2) general factors in stationary source testing; (3) chain-of-custody procedure; and (4) traceability protocol for gases used for continuous source emission monitors. The remainder of Volume III contains pollutant-specific quality assurance guidelines. Initially Volume III includes guidelines for the following pollutant-specific measurement systems: Section 3.5 Method 6 - determination of sulfur dioxide emissions from stationary sources, Section 3.6 Method 7 - determination of nitrogen oxide emissions from stationary sources, and Section 3.7 Method 8 -

determination of sulfuric acid mist and sulfur dioxide from stationary sources. Source testers and managers responsible for stationary source emission measurements will find Volume III useful in planning quality assurance.

35420 (PB—80-112345) **Development of an emission inventory quality assurance program. Final report.** Armentrout, D.W. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Jun 1979. Contract EPA-68-02-2585. 56p. NTIS, PC A04/MF A01.

This report discusses quality assurance in general and quality assurance related to emission inventories specifically. The inventory process is discussed in terms of its procedural elements. Typical error types and remedies are discussed. A suggested approach for developing a quality assurance program for emission inventories is given.

35421 (PB—80-113731) **Size-selective monitoring techniques for particulate matter in California air. Final report.** John, W.; Reischl, G.P.; Wesolowski, J.J. (California Dept. of Health, Berkeley (USA). Air and Industrial Hygiene Lab.). Feb 1978. Contract ARB-A5-A5-004-87. 103p. NTIS, PC A06/MF A01.

After a review of the criteria for a suitable size-selective monitoring instrument, the dichotomous virtual impactor and the cyclone were selected for evaluation. A cyclone was designed with a 50% cutoff of 3.5 micrometers at 1 5 l/min. The cyclone and the Sierra Model 243 dichotomous virtual impactor were tested extensively with monodisperse aerosol including both solid and liquid particles. Detailed measurements were made of particle deposition in the samplers as a function of particle size and air flow rate. Wall losses, reentrainment and uniformity of filter deposits were determined. The results of the tests show that both samplers are satisfactory for monitoring purposes.

35422 (PB—80-113756) **Empirical approach for relating annual TSP concentrations to particulate microinventory emissions data and monitor siting characteristics. Final report.** Pace, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA)). Jun 1979. 57p. NTIS, PC A04/MF A01.

Procedures for developing and applying an empirical procedure for relating microinventory data to annual TSP data is described herein. A microinventory is an inventory and orderly compilation of sources in the vicinity of a high volume sampler. Its purpose is to consolidate information on source emissions or activity rates, monitor siting, air quality data and land use characteristics into a consistent format and data base. The purpose of the microinventory is to assist in identifying the sources of particulate matter in close proximity to a monitoring site. Such information can subsequently be used to interpret observed differences in air quality at various monitoring sites. An empirical approach in which monitor siting characteristics and microinventory information are related to measured annual mean TSP concentrations using multiple regression analysis has been developed. The regression uses variables which consider the emissions and distances to both point and area sources and the effects of traffic and dust on nearby streets upon measured TSP concentrations. The purpose of this report is to describe: (1) the methodology used in compilation of a microinventory and (2) the development of uses of an empirical approach for relating observed annual TSP levels to microinventory and monitor siting information.

35423 (PB—80-113822) **Volatile organic compound (VOC) species data manual.** Bucon, H.W.; Macko, J.F.; Taback, H.J. (KVB, Inc., Tustin, CA (USA)). Dec 1978. Contract EPA-68-02-3029. 512p. NTIS, PC A22/MF A01.

This manual contains tables of potential emissions of organic compounds for selected source categories. The species profile table format has been organized to be particularly useful in preparation of emission inventory inputs to photochemical modeling. Accompanying each VOC profile table is a brief narrative that describes process, emissions, controls and basis of source report and data quantification. The chemical classifications include paraffin, olefin, aromatic, carbonyl (aldehydes and ketones), methane, non-reactive other than methane, and miscellaneous. Data confidence levels for each profile table have been assigned. Reference lists for reports, published data and names and titles of personal contacts are provided for each source category.

35424 (PB—80-120108) **Workbook for comparison of air quality models. Appendices. Guideline series.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). May 1978. 223p. NTIS, PC A10/MF A01.

The document consists of appendices to the Workbook for the Comparison of Air Quality Models. Appendix A presents guidance on emissions, plume dispersion, chemistry and reaction mechanisms, and physical removal processes. Appendix B provides background information on some suggested reference models. Examples of the application of the workbook methodology are presented in Appendix C.

35425 (PB—80-121171) **Journal holdings report - 1979.** (Environmental Protection Agency, Washington, DC (USA)). Nov 1979. 367p. NTIS, PC A16/MF A01.

The report is the sixth annual Journal Holdings Report of the EPA Library System. It represents the holdings of all EPA libraries and contains approximately 3,300 titles and 8,840 holdings.

35426 (PB—80-121221) **Sources of atmospheric cadmium. Final report.** Coleman, R. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Aug 1979. Contract EPA-68-02-2836. 116p. NTIS, PC A06/MF A01.

This report is one of a series of reports which will be used by EPA in responding to the Congressional request under Section 122 of the Clean Air Act Amendments of 1977 to determine whether atmospheric emissions of cadmium pose any threat to public health. This report surveys the used of cadmium and potential emission sources to determine which sources are the most significant both in terms of total emissions and potential ambient levels. It is estimated that about 850 tons of cadmium were emitted during 1974, with the largest estimated emitted of cadmium being the production of zinc. Other sources identified were incinerators, iron and steel mills, fossil fuel combustion, smelters.

35427 (PB—80-121445) **Example control strategy for ozone. Volume 1: general guidance for nonattainment areas. Final report.** (Association of Bay Area Governments, Berkeley, CA (USA)). Apr 1979. Contract EPA-68-02-3001. 133p. NTIS, PC A07/MF A01.

This guideline presents information to assist States and local agencies in preparing ozone control strategies for nonattainment areas. The guidance should be most useful in preparing 1982 State Implementation Plan revisions. The guideline covers the following topics: Intergovernmental Cooperation, Development and Assessment of Air Quality and Emissions Data, Modeling to Relate Air Quality to Emissions, Control Strategy Analysis and Assessment, Plan Adoption, and the Continuing Planning Process. This volume covers general guidance to nonattainment areas.

35428 (PB—80-123060) **Analysis of high NO2 concentrations in California, 1975-1977.** Martinez, J.R.; Nitz, K.C. (SRI International, Menlo Park, CA (USA)). Aug 1979. Contract EPA-68-02-2835. 105p. NTIS, PC A06/MF A01.

During the period 1975-1977, 51 monitoring stations in California collectively recorded about 1,800 site-days in which hourly nitrogen dioxide (NO2) concentrations exceeded 0.20 ppm. This work investigates potential causes of these high NO2 events, the physical phenomena involved in their occurrence, and their spatial and temporal patterns. In addition, the potential association between emission sources and the frequency and magnitude of high NO2 levels at the various locations is analyzed using detailed site-description data compiled in this study. The relationship between annual maximum hourly levels and annual mean concentration is explored, and the quality of the NO2 data is evaluated.

35429 (PB—80-124241) **Air quality modeling of gaseous and particulate dispersion from coal-fired power plants.** Layton, D.W.; Walther, E.G.; Williams, M.D. (Texas A and M Univ., College Station (USA). Zachry Engineering Center). 7 Nov 1973. 32p. NTIS, PC A03/MF A01.

The construction of large power plants in the pristine environment of the Southwest has brought to the fore many air quality questions. Among these are those of plume obscuration of distant terrain features, deposition of potentially harmful materials on water or land srfaces, ground uptake of contaminants, coversion of contaminants from one form to another, and the appropriate assumptions for plume behavior near elevated terrain. These questions are addressed through modification of existing dispersion models to provide prediction of dry deposition of materials, to account for ground uptake and conversion of one contaminant to another, and to provide predictions of plume obscuration of terrain features. The modifications are used to estimate the relevant parameters for a large coal burning power plant in the Southwest. In addition, a sensitivity analysis for differing assumptions of plume override near high terrain is presented.

35430 (PB—80-129653) **Linkages between the economy and the environment of the coastal zone of Mississippi. Part II: environmental model. Interim technical report.** Nissan, E.; Williams, D.C. Jr.; Green, T. (Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS (USA)). Jun 1979. 151p. NTIS, PC A08/MF A01.

This report is the middle link of three projects and its purpose is to determine the physical magnitudes of air, water and solid waste pollution generated through the economic activities of the coastal region of Mississippi. This is necessary for the subsequent stage where the linkage between the economic and environmental parts will be undertaken. Water effluent information gathered in this report was based primarily upon actual data provided by the Mississippi Air and Water Pollution Control Commission obtained as part of their monitoring of producing establishments. Other vehicles for collecting data had to be used such as secondary sources.

35431 (PB—80-802853) **Air pollution sampling of particles (a bibliography with abstracts). Report for 1964-November 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 209p. NTIS PCN01/MF N01.

This bibliography cites techniques of sampling particles in the earth's atmosphere. Discussed are sampling procedures, sampler design and performance, site selection, sampling networks, and meteorologicl effects. (This updated bibliography contains 202 abstracts, 83 of which are new entries to the previous edition.)

35432 (PB—80-803646) **Nitrogen oxide air pollution. Part 1. Control technology (citations from the American Petroleum Institute data base). Report for 1977-October 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jan 1980. 325p. NTIS PC N01/MF N01.

These citations pertain to air pollution control of nitrogen oxides from both stationary and mobile sources. Engine design, boiler combustion modification, fluidized bed combustion, and the use and design of other pollution control equipment are covered. (This updated bibliography contains 318 abstracts, 96 of which are new entries to the previous edition.)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 35390, 35465, 35466

35433 (DOE/EV/13573—T1, pp Paper 2, 13 pages) **Beryllium-7 in surface air.** Peirson, D.H.; Cambray, R.S. (AERE Harwell, Oxon, Great Britian). 1979.

From Natural radioactive isotopes of beryllium in the environment; Yale Univ., CT, USA (1-2 October 1979).

The concentration of Be-7 in surface air has been measured at 14 stations located between 70°N and 65°S, in some cases since 1964. The data are summarized and presented graphically to illustrate seasonal variation, latitude effects, and variation with time.

35434 (DOE/EV/13573—T1, pp Paper 3, 7 pages) **^{7}Be and ^{32}P in the Antarctic atmosphere.** Sanak, J.; Lambert, G. (Centre des Faibles Radioactivites, Gif-sur-Yvette, France). 1979.

In Natural radioactive isotopes of beryllium in the environment.

Since March 1977 the atmospheric concentration of ^{7}Be aerosols has been monitored daily at Dumont-Durville station (Terre Adelie - 66°40 South, 140° East). These data were completed after January 1978 by 32P measurements. These two nuclides appear to be in good correlation ($r = 0.9$). Mean monthly ^{7}Be concentrations of about 0.4 dpm/m^{3} were measured, therefore 1.5 time higher than at the South Pole. This result could be explained by the proximity of Dumont Durville to the geomagnetic pole. A small seasonal variation was observed, with maxima during the Austral Summer. This last effect is much more marked in the case of ^{32}P, whose mean annual concentration is about 6×10^{-3} dpm/m^{3}. Conclusions drawn from the ^{7}Be/^{32}P activity ratios are discussed. The mean monthly ratio is always greater than 40 at Dumont Durville. This result can only be explained by a stratospheric origin of ^{7}Be and ^{32}P, measured at sea level, in this station. Theoretical considerations show that, in the case of stratospheric air masses injected into the troposphere, the ^{7}Be/^{32}P activity ratio should be greater than the stratospheric limit of 100, and reach even about 200. This last value was actually observed a few times during our 2 year records. Good negative correlations observed between ^{7}Be concentrations and both ^{222}Rn concentrations and air humidity show that stratosphere to troposphere injections of spallation products happen at polar latitudes. This result would mean that most of the stratospheric materials detected in Antarctica are not transported at low altitude after an injection into the troposphere at mid-latitudes, but rather directly exchanged over the Antarctic continent.

35435 (DOE/EV/13573—T1, pp Paper 4, 28 pages) **Seasonal variations in the concentration of Be-7 in surface air.** Feely, H.W.; Volchok, H.L.; Sanderson, C. (Dept. of Energy, New York, NY). 1979.

In Natural radioactive isotopes of beryllium in the environment.

Concentrations of ^{7}Be in monthly filter samples of surface air have been measured at a number of sites in the Western Hemisphere since 1970. The seasonal variations in concentration at these sites show a number of different patterns that appear to reflect regional tropospheric meteorology. In general, higher concentrations of ^{7}Be are found at mid-latitude sites than at high latitude or low latitude sites. Concentrations are generally higher at high altitude sites than at sites at lower-elevations, and at continental sites than at sites under a marine influence. Mean annual concentrations range from 205 fCi/m^{3} at Mauna Loa Observatory, Hawaii (3401 m. elevation) to 35 fCi/m^{3} at Punta Arenas, Chile (53°S). The Arctic sites, Nord, Thule and Kap Tobin, Greenland and Barrow, Alaska show minimum concentrations during the summer quarter, June to August. In the Antarctic, at the South Pole Station, the highest concentrations of ^{7}Be occur during the summer quarter, December to February, and the lowest occur during the winter. This contrast with the pattern of seasonal variations in the Arctic may be related to the high elevation (2800 m.) of the South Pole Station. Most of our sites at temperate latitudes in North America show a broad maximum extending through the spring and summer, although this pattern is not followed at Miami, Florida or at sites on the west coast of the United States. Guayaquil, Ecuador, at 2°S latitude has low concentrations throughout the year. Most sites along the west coast of South America show concentration maxima during the warm months and minima during the cold months, although data do not fit this pattern.

35436 (EML—373) **Measured hourly and daily average ^{85}Kr concentrations within 10 km of the Savannah River Plant.** Gogolak, C.V.; Beck, H.L.; Pendergast, M.M. (Department of Energy, New York (USA). Environmental Measurements Lab.). Aug 1980. 130p. NTIS, PC A07/MF A01.

Mean hourly ground-level ^{85}Kr concentrations measured at six locations within 10 km of the Savannah River Plant chemical separations facilities during calendar year 1976 are presented in tabular form along with the mean daily concentrations for each site. These data, obtained with arrays of thin window G-M counters especially designed for this purpose, can be used to test point source atmospheric dispersion models.

REGULATIONS

REFER ALSO TO CITATION(S) 35427

35437 (PB—80-107998) **Handbook of key Federal regulations and criteria for multimedia environmental control. Final report, September 1978-June 1979.** Greenwood, D.R.; Kingsbury, G.L.; Cleland, J.G. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1979. Contract EPA-68-02-2612. 273p. NTIS, PC A12/MF A01.

The handbook summarizes major Federal environmental regulations and recommendations and the legislative acts that authorize them. It summarizes and tabulates quantitative control limits specified by Federal agencies. It compares the various regulations, standards, and criteria. It includes a selected bibliography addressing Federal environmental control activities.

35438 (PB—80-112089) **Review of standards of performance for new stationary sources: Portland cement industry.** Barrett, K.W. (Mitre Corp., McLean, VA (USA). METREK Div.). Oct 1978. Contract EPA-68-02-2526. 83p. NTIS, PC A05/MF A01.

This report reviews the current Standards of Performance for New Stationary Sources: Subpart F - Portland Cement Plants. It includes a summary of the current standards, the status of current applicable control technology, and the ability of plants to meet the current standards. No changes to the existing standard are recommended, but EPA should continue evaluation of sulfur oxide and nitrogen oxide controls with a view toward incorporating these emissions under the scope of the standard at a later date.

35439 (PB—80-119357) **Federal Register citations pertaining to the regulation of asbestos. In-house report.** Breen, J.J.; Bryan, E.F. (Environmental Protection Agency, Washington, DC (USA). Office of Toxic Substances). Apr 1979. 41p. NTIS, PC A03/MF A01.

Federal regulations governing the production and use of asbestos and asbestos-containing materials continue to focus their attention on the adverse health and environmental effects of asbestos. To obtain an appreciation of the scope of the current regulatory status of asbestos, a compilation was made of Federal Register citations pertaining to the regulation of asbestos by CPSC, DOT, EPA, FDA, MESA, and OSHA. An abstract of each citation was prepared and filed chronologically by statutory authority within the individual agencies. The resulting document, as presented here, provides a condensed source of information relating to the development of the various standards presently enforced by the agencies as well as proposals for new or modified regulations.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 35383

35440 (PB—80-802028) **Endangered species (a bibliography with abstracts). Report for 1964-November 1979.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 130p. NTIS PCN01/MF N01.

The selected abstracts cover wildlife management, animal ecology, plant ecology, aquatic animals, birds, highway construction, and air and water pollution as related to endangered species. (This updated bibliography contains 121 abstracts, 24 of which are new entries to the previous edition.)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 35425, 35430, 35589, 35648

35441 (PB—80-109051) **Investigation of sanitary landfill behavior. Volume I. Final report.** Fungarali, A.A.; Steiner, R.L. (Drexel Univ., Philadelphia, PA (USA)). Jul 1979. 333p. NTIS, PC A15/MF A01.

This two-volume report provides long-term information on the release of gaseous and liquid contaminants to the biosphere from decomposing, landfilled, municipal solid waste. Volume I, the comprehensive final report, presents results from a 6-year study. The investigation included studies of leachate migration, the relationship between contaminant concentration and leachate volume, field capacities for various sizes of milled refuse, influence of density and depth on leachate pollutant concentrations, and the relationship of leachate chemical components to each other and to leachate volume.

35442 (PB—80-109168) **Analytical protocols for making a preliminary assessment of halogenated organic compounds in man and environmental media.** Pellizzari, E.D.; Erickson, M.D.; Zweidinger, R.A. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jul 1979. Contract EPA-68-01-4731. 319p. NTIS, PC A14/MF A01.

This comprehensive report presents the methods which will be used in Phase II of this program. Analytical methods for halogenated hydrocarbons in air, water, soil, breath, blood, urine, and tissue have been validated. A radioimmunoassay procedure for carcinoembryonic antigen (CEA) was validated. The data collection instruments (participant consent form, questionnaire, etc.) are also presented here.

35443 (PB—80-802812) **Sanitary landfills. Volume 1. 1964-1977 (citations from the NTIS data base). Report for 1964-1977.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 279p. NTIS PCN01/MF N01.

The reports cited relate to sanitary landfill criteria, design, site selection, guidelines, urban and rural locations, and land reclamation. Research on disposal of municipal refuse, dredge spoil, sewage sludge, and sludges from pollution control in power plants is covered. Studies on economics, government policies, management, and public health are included. Ground water pollution, land reclamation, gaseous emissions, leachate analyses, landfill liners, esthetics, and monitoring are discussed. Land disposal of hazardous materials is excluded. (This updated bibliography contains 272 abstracts, none of which are new entries to the previous edition.)

35444 (PB—80-802820) **Sanitary landfills. Volume 2. 1978-November 1979 (citations from the NTIS data base). Report for 1978-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 75p. NTIS PCN01/MF N01.

The reports cited relate to sanitary landfill criteria design, site selection, guidelines, urban and rural locations, and land reclamation. Research on disposal of municipal refuse, dredge spoil, sewage sludge, and sludges from pollution control in power plants in landfills is covered. Studies on economics, government policies, management, and public health are included. Ground water pollution, land reclamation, gaseous emissions, leachate analyses, landfill liners, esthetics, and monitoring are discussed. Land disposal of hazardous materials is excluded. (This updated bibliography contains 68 abstracts, 35 of which are new entries to the previous edition.)

35445 (PB—80-802838) **Sanitary landfills. Volume 1. 1970-1977 (citations from the Engineering Index data base). Report for 1970-1977.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 279p. NTIS PCN01/MF N01.

Citations of worldwide reports on refuse disposal in sanitary landfills are presented. Studies covered are site selection, refuse processing, earth moving equipment, and monitoring. The majority of these abstracts concern water pollution and gas evolution at disposal locations. The recovery of landfill gas for use as a fuel is discussed. Landfill disposal of hazardous materials is excluded. (This updated bibliography contains 272 abstracts, none of which are new entries to the previous edition.)

35446 (PB—80-802846) **Sanitary landfills. Volume 2. 1978-November 1979 (citations from the Engineering Index data base). Report for 1978-November 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 93p. NTIS PCN01/MF N01.

Citations of worldwide reports on refuse disposal in sanitary landfills are presented. Studies covered are site selection, refuse processing, earth moving equipment, and monitoring. The majority of these abstracts concern water pollution and gas evolution at disposal locations. The recovery of landfill gas for use as a fuel is discussed. Landfill disposal of hazardous materials is excluded. (This updated bibliography contains 86 abstracts, 37 of which are new entries to the previous edition.)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

SOIL

35447 (PNL—3498) **Potential airborne release from soil-working operations in a contaminated area.** Sutter, S.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 30p. NTIS, PC A03/MF A01.

Experiments were performed to provide an indication of how much material could be made airborne during soil-working operations in a contaminated area. Approximately 50 kg of contaminated soil were collected, dried, and mixed, and particle size distribution and ^{137}Cs content were characterized. In four experiments performed in a 2 ft x 2 ft wind tunnel at the Radioactive Aerosol Release Test Facility, soil was pumped into an airstream moving at 3.2, 10.4, 15.2, and 20 mph. These experiments were designed to maximize airborne releases by fluidizing the soil as it was pumped into the wind tunnel. Thus the airborne releases should represent upper limit values for soil-working operations. Airborne concentration and particle size samples were collected and all of the material deposited downstream was collected to calculate a mass balance. The fraction airborne was calculated using these measurements.

35448 **Plutonium in a grassland ecosystem at Rocky Flats.** Little, C.A.; Whicker, F.W.; Winsor, T.F. (Colorado State Univ., Ft. Collins). *J. Environ. Qual.;* **9**: No. 3, 350-354(Jul 1980).

Portions of the grassland around the Rocky Flats installation of the US Department of Energy, located about 12 km northwest of the Denver metropolitan area, were contaminated with Pu between 1959 and 1964. This study was designed to elucidate the Pu distribution patterns in the terrestrial ecosystem immediately downwind of the contamination source. It was concluded that wind erosion of contaminated soil was likely the chief mechanism of plutonium transport and that soil contained 99.7% of the plutonium in the system. Plant and small animal compartments combined contained less than 0.3% of the total Pu inventory which averaged about 53 $\mu Ci/m^2$ in the study area.

35449 **Uranium in soil around phosphate processing plants in Pocatello, Idaho.** Johnson, R.; Wai, C.M.; McVeety, B.; Lee, H.; Willmes, H. (Univ. of Idaho, Moscow). *Bull. Environ. Contam. Toxicol.;* **24**: No. 5, 735-738(May 1980).

A study was conducted on the distribution of uranium in soil around two phosphate processing plants as a function of distance, depth, and prevalent wind direction of the area. Such information is essential for understanding the dispersion of uranium and its daughter products into the environment by the phosphate processing operations. Soil samples were collected at different depths along three lines radiating from the center of the two plants. U concentrations in soil were determined by neutron activation analysis. Results are reported.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 35448, 35471

35450 (CONF-800334—22) **Residual radioactivity in the vicinity of formerly utilized MED/AEC sites.** Haywood, F.F.; Goldsmith, W.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From 2. DOE environmental control symposium; Reston, VA, USA (17 Mar 1980).

As demand for uranium and thorium was accelerated during the 1940's, services of chemical and metallurgical firms and major research facilities were contracted as needed by the Manhattan Engineer District (MED). A lack of documentation of the radiological status at the time contracts were terminated at these facilities led the Department of Energy (DOE), and its predecessor the Energy Research and Development Administration (ERDA), to develop a major radiological resurvey program to fill this information void. A combination of aerial and ground-level radiological monitoring teams were utilized to identify and assess off-site radioactivity. Results from comprehensive aerial surveys provide the approximate

areal extent of elevated radiation levels on the ground. These aerial survey results led to two types of ground-level surveys: (1) gamma-ray scanning on foot or from a motorized vehicle (mobile lab based system) to pinpoint the location of residual radioactivity; and (2) compehensive radiological surveys to determine the amount and type of materials present on specific parcels of private and public property identified during the scanning. This type of investigation was initiated in 1978 and has been successful in identifying and assessing the potential radiation hazard from property on which materials bearing natural radioactivity have been found. This paper contains a description of the techniques used to find and evaluate radioactive material displaced outside the boundaries of a formerly utilized site.

35451 (PB—80-110893) **Estech General Chemicals Corporation, Duette Mine, Manatee County, Florida. Resource document: radiological environment. Draft environmental impact statement.** (Bolch (W. Emmett), Gainesville, FL (USA)). Oct 1979. 98p. NTIS, PC A05/MF A01.

The site is unaltered except for agricultural uses and the baseline radiological condition can be readily measured. The mining to the northeast in the west central Florida phosphate area has been extensively studied and can serve as a point of reference for the proposed site. The document describes the background condition of the natural radiation environment in the absence of the proposed mining facilities. The only radionuclides having potential for significant impact are those of the uranium-238 decay series. The relative importance of the thorium-232 series are addressed. The discussion centers upon the natural and disturbed condition of uranium-238 series radionuclides. Specific items to be covered include uranium associated with the phosphate, the uranium series including radium-226 and radon-222, radon progeny, terrestrial gamma radiation, airborne radioactivity, subsurface profiles of radioactivity, radium-226 in surface waters, and radium-226 in groundwaters.

35452 Foliar absorption of transuranic elements: influence of physiochemical form and environmental factors. Cataldo, D.A.; Garland, T.R.; Wildung, R.E.; Thomas, J.M. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *J. Environ. Qual.;* **9**: No. 3, 364-369(Jul 1980).

The accumulation of plutonium (^{238}Pu) and americium (^{241}Am) in seeds and roots of Phaseolus vulgaris L. was investigated following foliar interception. Under controlled conditions plants were exposed to well-characterized aerosols of fresh and aged Pu-dioxide, fresh Am-oxides, and Pu-nitrate and Pu-citrate complexes to assess the influence of chemical form and long-term weathering on foliar absorption and subsequent translocation to other plant parts. Mean values for Pu and Am accumulated in seeds and roots 28 days after foliar exposure ranged from 9 to 427 x 10^{-4}% of that deposited on foilage. These results and previous plant uptake studies indicate that the foliar route is potentially of equal importance to the soil-root pathway as a route of transport. The levels of Pu and Am in seeds and roots resulting from foliar absorption and translocation from foilage were significantly affected by simulated rainfall and by the size of particles to which foilage was exposed. The influence of relative humidity and solution aging of oxides was less definitive; however, results suggest that either or both may infuence foliar absorption and subsequent translocation of Pu and Am to seeds and roots.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 34507, 34583, 34604, 34606, 34609, 34631, 35098, 35451, 35473, 35658, 35659, 35660, 35663

35453 (PB—80-110927) **Estech General Chemicals Corporation, Duette Mine, Manatee County, Florida. Resource document: socioeconomics. Draft environmental impact statement.** (Planning/Marketing Services, Inc., Sarasota, FL (USA)). Oct 1979. 78p. NTIS, PC A05/MF A01.

Contents: Demography; Economy; Land use; Community services and facilities; Sensitive manmade areas.

35454 Utilization and disposal of fly ash and other coal residues in terrestrial ecosystems: a review. Adriano, D.C.; Page, A.L.; Elseewi, A.A.; Chang, A.C.; Straughan, I. (Savannah River Ecology Lab., Aiken, SC). *J. Environ. Qual.;* **9**: No. 3, 333-344(Jul 1980).

Impacts of land-oriented utilization and disposal of various coal combustion residues are summarized. The physical and chemical properties of coal ashes are dependent on the coal's geological origin, combustion condition, efficiency of particulate removal, and degree of weathering before final disposal. Coal residues, applied on cropland, are not practical sources of essential plant nutrients N, P, and K; however, they can effectively serve as a supplementary supply of Ca, S, B, Mo, and Se to soils. Fly ash could also be an effective amendment in neutralizing soil acidity. Many of the observed chemical and biological effects of fly ash applications to soils resulted from the increased activities of Ca^{2+} and OH^- ions. Most unweathered fly ashes, especially those coming from the subbituminous and lignite coals of the western US, are high in these constituents and usually will cause high soil salinity. The accumulation of B, Mo, Se, and soluble salts in fly ash-amended soils appear to be the most serious constraints associated with land application of fly ash to soil.

REGULATIONS

REFER ALSO TO CITATION(S) 35437

ENVIRONMENTAL SCIENCES, AQUATIC

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 35383, 35440

35455 (DOE/EV/01340—T1) **Variability within the ocean-atmospheric system over the North Pacific.** Ciesielski, P.E. (Colorado State Univ., Fort Collins (USA)). 1980. Contract AS02-76EV01340. 154p. NTIS, PC A08/MF A01.

Thesis.

Characteristics of the oceanic mixed layer over the North Pacific were examined utilizing a number of statistical methods. Based on the analyses of twelve years of data, a quasi-meridional differentiation (QMD) in sea surface temperature (SST) spectra across the North Pacific was observed. The SST spectra became increasingly red as an increasing function of latitude. A strong 21 to 26 day cycle in SST anomalies is discussed which may be a reflection of heat fluxes. These fluxes also vacillate significantly on this time-scale in conjunction with cycles observed in the atmospheric energy modes of available potential and kinetic energy. Examination of an oceanic heat budget on a spatial and temporal basis suggest that the impact of latent and sensible heat fluxes upon ΔSST is partially a function of the magnitude of the heat fluxes as well as of the depth to which their effects are mixed. The heat budget analyses and the fitting of power spectra of SST anomalies over the North Pacific to a two-parameter oceanic model, suggest that SST behavior over the mid-oceanic regions of the North Pacific is dominated by the influence of latent and sensible heat fluxes. On the other hand, over the remainder of the North Pacific one could surmise that other processes, such as advection of heat within the ocean, the entrainment heat flux at the base of the mixed layer, and radiation are at least as important in determining the behavior of SST's. By analyzing anomalous patterns of atmospheric thickness and SST's, it appears that the modification of air masses as they are advected over oceanic waters, as well as the stability of the lower atmosphere, are instrumental factors in determining the nature of large-scale air-sea heat exchange processes.

35456 (PB—80-110034) **Chalk Point steam electric station studies Patuxent estuary studies: ichthyoplankton population studies, 1978 data report. Final report.** Setzler, E.M.; Wood, K.V.; Shelton, D.; Drewry, G. (Maryland Univ., Solomons (USA). Chesapeake Biological Lab.). Jun 1979. 120p. NTIS, PC A06/MF A01.

The surveys are part of a series of studies designed to help evaluate the effect of the Chalk Point Generating Station on the Patuxent Estuary. Objectives of the study were to determine spatial and temporal distribution of fish eggs and larvae in the river during the period March 21, 1978 to August 23, 1978. Also included are the results of three nearfield studies to obtain detailed distributions of ichthyoplankton near the site.

35457 (PB—80-112261) **Survey of larval fish in the Michigan waters of Lake Erie, 1975 and 1976. Final report, 1975-1978.** Waybrant, R.C.; Shauver, J.M. (Michigan Dept. of Natural Resources, Lansing (USA). Water Quality Div.). Aug 1979. 97p. NTIS, PC A05/MF A01.

Surveys in 1975 and 1976 in the Michigan waters of Lake Erie assessed the relative abundance and distribution of larval fish. Seasonal fluctuations, patterns of distribution, and depth preferences were noted for the 24 larval fish taxa identified. Special emphasis was placed on four target species, walleye (Stizostedion vitreum), yellow perch (Perca flavescens), white bass (Morone chrysops) and channel catfish (Ictalurus punctatus). Of these 4 species only yellow perch and white bass were found more than occasionally. Of the remaining 20 species collected during the study only 5 were regularly captured. The northern and southern extremes of the study area

held many more fish than the central portion. The 0- to 12-ft depth zone had the largest concentrations of larval fish and concentrations gradually decreased as the depth increased.

35458 (PB—80-120074) **Ocean variability in the US Fishery Conservation Zone, 1976.** Goulet, J.R. Jr; Haynes, E.D. (National Marine Fisheries Service, Seattle, WA (USA)). Jul 1979. 364p. NTIS, PC A16/MF A01.

Some responses of fisheries resources to natural climate-ocean variability in 1976 are summarized. Emphasis is on the US Fisheries Conservation Zone. Areas in which the United States has an established fishery or commercial interest in a local fishery are also considered. Contributed papers present various aspects of the marine climate in 1976. The purpose of the report is to provide researchers with an information source on the ocean properties and processes influencing fishery resources.

35459 (PB—80-802259) **Water resources in arid and semiarid regions (a bibliography with abstracts). Report for 1964-September 1979.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 249p. NTIS PCN01/MF N01.

The citations cover reports concerned with water quality, resource management, potable water, consumption, and irrigation as they apply to arid and semiarid regions, particularly those in the western regions of the United States. Hydrology, modeling, and water allocation are also covered along with studies on water conservation measures, which will add to the water resources in these areas. (This updated bibliography contains 243 abstracts, 52 of which are new entries to the previous edition.)

35460 **Bacterioplankton secondary production estimates for coastal waters of British Columbia, Antarctica, and California.** Fuhrman, J.A.; Azam, F. (Univ. of California, San Diego, La Jolla). Contract AC03-79EV70020. *Appl. Environ. Microbiol.;* **39**: No. 6, 1085-1095(Jun 1980).

The principal obtective of this study was to quantify the rate of heterotrophic bacterioplankton production. Production was estimated by two approaches: (i) measurement of increasing bacterial abundance with time in filtered (3-μm pore size) seawater and (ii) estimation of bacterial deoxyribonucleic acid synthesis by tritiated thymidine incorporation in unfractionated seawater. The two approaches yielded comparable results when used at the Controlled Ecosystem Population Experiment (Saanich Inlet, British Columbia, Canada), at McMurdo Sound (Antarctica), and off Scripps Pier (La Jolla, Calif.). Estimated bacterioplankton production was lower in Antarctic samples (ranging from ~ 0 to 2.9 μg of C liter^{-1} day^{-1}) than in those from the other two sites (ranging from 0.7 to 71 μg of C liter^{-1} day^{-1}). In all three regions studied, it appeared that a significant fraction of the total primary production was utilized by the bacterioplankton and that substantial growth could occur in the absence of large particles. These results support the conclusion that bacterioplankton are a quantitatively important component of coastal marine food webs.

35461 **Characterization of benthic microbial community structure by high-resolution gas chromatography of fatty acid methyl esters.** Bobbie, R.J.; White, D.C. (Florida State Univ., Tallahassee). Contract 31-109-38-4502. *Appl. Environ. Microbiol.;* **39**: No. 6, 1212-1222(Jun 1980).

Fatty acids are a widely studied group of lipids of sufficient taxonomic diversity to be useful in defining microbial community structure. The gas-liquid chromatographic analyses are both reproducible and highly sensitive, and the recovery of fatty acids is quantitative. The analyses can be automated, and the diagnostic technique of mass spectral fragmentation analysis can be readily applied. Reciprocal mixtures of bacteria and fungi, when extracted and analyzed, showed progressive changes of distinctive fatty acid methyl esters derived from the lipids. By manipulating the environment of an estuarine detrital microbial community with antibiotics and culture conditions, it was possible to produce a community greatly enriched in eucaryotic fungi, as evidenced by scanning electron microscopic morphology. The fatty acid methyl C_{18} dienoic and the C_{18} and C_{20} polyenoic esters. Manipulation of the detrital microbiota that increased the procaryotic population resulted in an absence of large structures typical of fungal mycelia or diatoms, as evidenced by scanning electron microscopy, and a significantly larger proportion of anteiso and isobranched C_{15} fatty acid esters, C_{17} cyclopropane fatty acid esters, and the cisvaccenic isomer of the C_{18} monoenoic fatty acid esters. As determined by these techniques, a marine settling community showed greater differences in bacterial as contrasted to microeucaryotic populations when compared with the microbial communities of benthic cores.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 34469, 34490, 34506, 34539, 34555, 34556, 34557, 34558, 34559, 34560, 35233, 35389, 35402, 35417, 35425, 35430, 35441, 35589, 35648

35462 (LMF—69, pp 550-554) **Preparation, generation and characterization of fibrous glass aerosols.** Pickrell, J.A.; Carpenter, R.L.; Sass, K.S.; Straus, F.C.; Griffis, L.C.; DeNee, P.B.; Mokler, B.V.; Hobbs, C.H. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The health-related consequences of conserving energy from the increased use of fibrous glass insulation materials are being evaluated. Fibers were prepared from several commercial insulating materials and one experimental microfiber material. The prepared fibers resembled those sampled in the workers' breathing zone and in the general workplace during manufacture and installation of these insulating materials. Under optimum conditions, approximately 20% of the prepared fibers were respirable (< 1.5 μm real .diameter) and longer than 20 μm. Fibers of these dimensions are known to cause pulmonary injury. Experimental microfibers were selected for the first aerosol exposure because they had the greatest number of long, thin fibers per unit mass. A fluidized bed generator was used to produce an aerosol cloud of approximately 30 mg/m^3 of respirable material. Number concentrations of microfibers longer than 20 μm were calculated to be approximately 1500 fibers per cm^3. These high concentrations permitted studying biomedical responses at exposure levels substantially in excess of current or proposed safety standards.

35463 (PB—80-128580) **Drinking-water quality and variations in water levels in the fractured crystalline-rock aquifer, west-central Jefferson County, Colorado. Water-resources investigations (interim).** Hall, D.C.; Johnson, C.J. (Geological Survey, Lakewood, CO (USA). Water Resources Div.). Sep 1979. 57p. NTIS, PC A04/MF A01.

In parts of the area, water for domestic use obtained from the fractured crystalline-rock aquifer contained excessive concentrations of dissolved fluoride, dissolved nitrite plus nitrate, dissolved solids, dissolved iron, dissolved manganese, dissolved zinc, coliform bacteria, gross alpha radiation, and gross beta radiation. Based on water-quality analyses from 26 wells located in small urbanized areas, water from 21 of the wells contained excessive concentrations of one or more constituents. Local variations in concentrations of 15 chemical constituents, specific conductance, and water temperature were statistically significant. Depths to water in 11 non-pumping wells ranged from 1 to 15 feet annually. Three-year trends in water-level changes in 6 of the 11 wells indicated a decrease in stored water in the aquifer.

35464 (PB—80-803919) **Biodeterioration of oil spills (citations from the NTIS data base). Report for 1964-January 1980.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Jan 1980. 138p. NTIS PC N01/MF N01.

The selected abstracts report on algae, bacteria, hydrocarbons, petroleum degradation, oil spills, beach cleanups and microbial degradation as related to biodeterioration of oil spills. (This updated bibliography contains 131 abstracts, 7 of which are new entries to the previous edition.)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

WATER

REFER ALSO TO CITATION(S) 35463

35465 (DOE/EV/13573—T1) **Natural radioactive isotopes of beryllium in the environment.** (Yale Univ., New Haven, CT (USA)). 1979. Contract AS02-76EV13573. 178p. NTIS, PC A09/MF A01.

Each of the papers was abstracted in dividually for ERA/EDB/INIS. (JGB)

35466 (DOE/EV/13573—T1, pp Paper 6, 32 pages) **Aerosol deposition velocities on the Pacific and Atlantic oceans calculated from ^{7}Be measurements.** Young, J.A.; Silker, W.B. (Pacific Northwest Lab., Richland, WA). 1979.

In Natural radioactive isotopes of beryllium in the environment.

The concentrations of ^{7}Be were measured in Pacific and Atlantic ocean water for past several years to determine the deposition velocity of aerosol particles on the ocean surface. Beryllium-7 is produced at a relatively constant rate in the atmosphere by spallation reactions of cosmic rays with atmospheric nitrogen and oxygen. Immediately after its formation ^{7}Be becomes attached to aerosol particles, and therefore can serve as tracers of the subsequent behav-

ior of these particles. Isopleths of ^{7}Be surface water concentration, ^{7}Be inventory in the ocean, and deposition velocity have been prepared for the Pacific Ocean from 30°S to 60°N and for the Atlantic Ocean from 10°N to 55°N. The concentrations, inventories and deposition velocities tended to be higher in regions where precipitation was high, and generally increased with latitude. The average flux of ^{7}Be across the ocean surface was calculated to be 0.027 atoms cm^{-2} sec^{-1} which is probably not significantly greater than the worldwide average ^{7}Be flux across land and ocean surfaces of 0.022 atoms cm^{-2} sec^{-1} calculated by Lal and Peters. The average deposition velocity was calculated to be 0.80 cm sec^{-1}. This value may be 10 to 30% too low, since it was calculated using atmospheric ^{7}Be concentrations which were measured at continental stations. Measurements of atmospheric ^{7}Be concentrations at ocean stations suggest that the concentrations at the continental stations averaged 10 to 30% higher than the concentrations over the ocean.

35467 (DOE/EV/13573—T1, pp Paper 7, 6 pages) **Be-7 in the study of particle mixing rates in nearshore and lake sediments.** Krishnaswami, S.; Benninger, L.K.; Aller, R.C.; Von Damm, K.L. (Yale Univ., New Haven, CT). 1979.

In Natural radioactive isotopes of beryllium in the environment.

The use of cosmogenic Be-7 (half-life 53.3 days) was investigated as a tracer for short-term particle-mixing in nearshore marine and lake sediments. The study included three parts: measurement of atmospheric deposition of Be-7 at New Haven, Connecticut; comparison of short-term mixing rates as deduced from distributions of excess Th-234 and Be-7 in sediments of Long Island Sound; and determination of short-term mixing rates in sediments of Lake Whitney, New Haven, Connecticut.

35468 (DOE/EV/13573—T1, pp Paper 8, 2 pages) **^{7}Be in estuarine sediments.** Cutshall, N.H.; Larsen, I.L. (Oak Ridge National Lab., TN). 1979.

In Natural radioactive isotopes of beryllium in the environment.

^{7}Be is measured directly in surficial sediments in a low-level gamma-ray spectrometer. Nominal 200-gram samples are placed in a 550-cm^{3} Marinelli beaker on a Ge(Li) detector for 200-minute counting times. Using a detector with 22% relative photopeak efficiency and 1.8 Kev FWHM resolution yields one count per 630 disintegrations and a detection limit of approximately 60 pCi. Surficial sediments taken from the James and Susquehanna Rivers and from Chesapeake Bay were analyzed. Concentrations of ^{7}Be found range from not detectable to 2.6 pCi/g corresponding to areal concentrations as high as 1.7 pCi/cm^{2}. ^{7}Be is more frequently found in sediments taken from zones of high deposition rate than in low deposition areas. Highest concentrations are found in the high deposition rate area associated with the turbidity maximum in the James. Whether or not salinity directly affects ^{7}Be concentrations is not apparent in the present data. ^{7}Be is present in sediments taken from fresh and brackish areas with salinities as high as 15 to 20%. Higher salinity areas have not yet been sampled.

35469 (DOE/EV/13573—T1, pp Paper 9, 10 pages) **Behavior of ^{7}Be in Sargasso Sea and Long Island Sound waters.** Aaboe, E.; Dion, E.; Turekian, K.K. (Yale Univ., New Haven, CT). 1979.

In Natural radioactive isotopes of beryllium in the environment.

Previously reported results indicated that the standing crop of ^{7}Be in Lake Whitney sediments was that predicted by atmospheric flux, whereas the three Long Island Sound cores were markedly deficient in ^{7}Be. The difference between the fresh water and marine sediments could be ascribed to the greater efficiency of adsorption of reactive species on particles in low ionic strength waters observed for other nuclides such as ^{137}Cs. If this indeed were the case then the remainder of the ^{7}Be expected from the precipitation should be found in the Long Island Sound water column. ^{7}Be was determined in open seawater samples and in water from Long Island Sound. The open ocean seawater standing crops were found to be compatible with those expected from precipitation data. The ^{7}Be concentration of a Long Island Sound water sample was found to be less than 240 dpm/1000 l, which corresponds to a standing crop of less than 0.5 dpm/cm^{2} for a mean depth of 20 meters. These results indicate that the water column cannot satisfy the previously described deficiency, adding only 0.5 dpm/cm^{2} to the sediment standing crop of about 2 dpm/cm^{2}, compared to 4 to 5 dpm/cm^{2} predicted from the atmospheric precipitation data. It is concluded that there is another sink for ^{7}Be in the Long Island Sound system, possibly the salt marshes on the margins of the Sound. (JGB)

35470 **Solution species of plutonium in the environment.** Rai, D.; Serne, R.J.; Swanson, J.L. (Batelle Pacific Northwest Lab., Richland, WA). *J. Environ. Qual.;* 9: No. 3, 417-420(Jul 1980).

Information regarding the oxidation states of Pu in environmental samples is needed for estimating its migration through the geologic media. Predictions based upon thermodynamic data indicate that in the Eh-pH range of natural aqueous environments, the dominant species of Pu is likely to be Pu[V] in relatively oxidizing environments and Pu[III] in reducing environments. Because of the lack of methods of determining Pu[V] in environmental samples containing trace concentrations of Pu, Pu[V] has not been previously identified in these samples. Plutonium [VI] has generally been assumed to be the dominant species in relatively oxidizing environments. However, the results presented show that solutions in equilibrium with ^{239}Pu[IV] hydroxide contain Pu[V]. The presence of Pu[V] in solutions contacting $^{239}PuO_{2}$(s) is also inferred from the data.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 35451

35471 (PNL—3127) **Radiological survey of exposed shorelines and islands of the Columbia River between Vernita and the Snake River confluence.** Sula, M.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1980. Contract AC06-76RL01830. 163p. NTIS, PC A08/MF A01.

This document describes a radiological survey which was performed to evaluate the magnitude and distribution of radioactive contamination on the exposed shorelines of the Columbia River along and downstream of the Hanford Site. The area encompassed by the survey includes the low-lying exposed land on both sides of the river from the uppermost point of production reactor discharge into the river at 100-B Area to the confluence of the Snake and Columbia Rivers, almost 60 miles downstream of the starting point. External exposure rate measurements were made at nearly 30,000 locations during the survey - accounting for approximately 60% of the land in the study area. Measurable radioactive contamination, resulting from past Hanford operations was found to be present on the shorelines of the Columbia River along the study area. The absence of short-lived radionuclides in the shore sediments and the presence of contamination several meters above recent maximum river levels indicate that the material was deposited some years ago.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 35584

35472 (PB—80-111743) **Evaluation of the effects of the Morgantown SES cooling system on spawning and nursery areas of representative important species. Final report.** Polgar, T.T.; Summers, J.K.; Haire, M.S. (Martin Marietta Corp., Baltimore, MD (USA). Environmental Center). Oct 1979. 149p. NTIS, PC A07/MF A01.

Power plant cooling system entrainment and plume entrainment may reduce the sizes of fish, benthic and other populations through the destruction of early life stages. This document has been prepared to estimate the potential effects and impacts of entrainment by the Morgantown (PEPCO) and Possum Point (VEPCO) steam electric generating stations. Maryland water quality regulation requires the determination of entrainment effects on spawning and nursery areas of consequence for the Representative Important Species (RIS) designated within the regulation. The purpose of this evaluation is to provide information for regulatory decisions regarding the need for alternative cooling modes at existing facilities. Caclulation schemes are presented to estimate the individual and cumulative entrainment effects due to the operations of both the Morgantown and Possum Point facilities. Potential adult population losses due to the entrainment of early life stages were estimated for 24 RIS populations.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 34536, 35065

35473 (PB—80-108442) **Baltimore metropolitan coastal area study - an agenda for action.** (Regional Planning Council, Baltimore, MD (USA)). Mar 1978. 160p. NTIS, PC A08/MF A01.

This study was produced by the cooperative action of 4 jurisdictions - Harford County, Baltimore County, Baltimore City, and Anne Arundel County - along with the Regional Planning Council, the Department of Natural Resources and several other State agencies. This document represents their frank estimation of what should be done within the Baltimore metropolitan coastal area to better preserve resources and control the use of land. It is not a 'plan' but rather a set of recommendations on actions to be taken by the participants in coastal decision-making - citizens, local governments, regional groups, and state government. This document can be used as a guide to the region's attempt to coordinate action, build

consensus, and resolve conflict in the preservation, conservation, and use of its coastal lands and waters.

REGULATIONS

REFER ALSO TO CITATION(S) 35437

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 35430

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 34546, 34579, 34582, 34604

35474 (PB—80-111628) **Alaska OCS socioeconomic studies program. Technical report No. 26. Developing predictive indicators of community and population change. Final report.** Kruse, J.A.; Hitchins, D.; Baring-Gould, M. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). 13 Apr 1979. Contract DI-AA550-C76-61. 510p. NTIS, PC A22/MF A01.

The goal of the Predictive Indicator Study is to improve our ability to anticipate the social and economic effects of energy developments on Alaskan communities. The primary problem addressed by the research is that the same general type of energy development is likely to result in different changes among individuals and communities. This report presents results of research that attempts to explain these differences. The explanation is based on the idea that observable community and individual characteristics somehow influence the effects of outside forces of change. The authors have drawn upon the oil pipeline impact experiences of Fairbanks and Valdez, Alaska to identify the relationships between community and individual characteristics that can be observed prior to impact on the one hand and impact experiences and assessments on the other. These relationships may be shown in future studies to apply to communities and individuals generally, or at least to apply to a large proportion of the population which may be affected by such energy developments. To the extent that the relationships appear to have a general application, they can be used in combination with observations of specific community characteristics and development forces to predict likely patterns of impact.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 35526

35475 **Caloric values for young sprouts of nine hardwood species.** Neenan, M. (An Foras Taluntais, Oak Park, Carlow, Ireland); Steinbeck, K. Contract EG-77-5-09-1015. *For. Sci.;* **25**: No. 3, 455-461(Sep 1979).

Caloric content, specific gravity, and ash content of 6- to 15-year-old sprouts of nine hardwood species were determined in midsummer. Energy values for wood, bark, first order branches, twigs, and leaves were determined with an adiabatic bomb calorimeter. The values found for coppice material averaged 4791 cal/g and were comparable to published values for older wood. Intraspecific differences among tissues were greater than the relatively small but significant differences among species. Differences in yield potential are therefore likely to outweigh variations in caloric content among species where total energy production per unit of land area is concerned. Ash content varied from 0.65 percent for wood to 5.88 percent for bark.

ENVIRONMENTAL IMPACT STATEMENTS

35476 (OCS—53(Vol.1)) **Proposed 1981 outer continental shelf oil and gas lease sale offshore central and northern California, OSC Sale No. 53. Final environmental impact statement.** (Bureau of Land Management, Washington, DC (USA)). Sep 1980. 769p. Bureau of Land Management, Washington, DC.

This Environmental Impact Statement (EIS) was prepared by the Bureau of Land Management's Pacific Outer Continental Shelf Office. Proposed OCS Sale No. 53 includes a maximum offering of 242 tracts for oil and gas leasing offshore central and northern California. Tracts comprise 532,258 hectares (1,315,205 acres) on the Federal OCS, ranging seaward from 3 to as far as 27 miles, and lying in water depths from 50 to 750 meters (62 to 2437 feet). Tracts comprise five distinct subareas, extending from waters opposite Humboldt Bay in northern California to offshore waters opposite Point Conception in central California. There are no Federal oil and gas leases in the area at present. Very minor exploratory drilling has occurred in some areas previously. Because it is a frontier area, the exact extent of oil and gas resources which might be present is somewhat uncertain. The US Geological Survey estimates the most probable resource amounts at 548 million barrels of oil and 621 billion cubic feet of gas. Four of the subareas are regarded as oil prone, while all five are regarded as also likely containing gas. Pending final decision by the Secretary of the Interior, the proposed lease Sale is tentatively scheduled for May 1981. The scoping process and coordination with other Federal agencies identified the following environmental issues and areas as meriting special attention and emphasis in the environmental assessment process: (1) air quality; (2) water quality; (3) marine and coastal ecosystems; (4) endangered species; (5) proposed marine sanctuaries; (6) commercial fishing; (7) recreation and sportfishing; (8) socio-economics; (9) land use; (10) transportation systems; (11) military use; (12) archaeological and cultural resources; and (13)) visual resources.

35477 (OCS—53(Vol.2)) **Proposed 1981 outer continental shelf oil and gas lease sale offshore central and northern California, OCS Sale No. 53. Environmental impact statement.** (Bureau of Land Management, Washington, DC (USA)). Sep 1980. vp. Bureau of Land Management, Washington, DC.

This volume contains maps and charts in support of the Final Environmental Impact Statement prepared by the Bureau of Land Management's Pacific Outer Continental Shelf Office for the proposed OCS Sale No. 53. (DMC)

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 35644

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 34665, 35461, 35514, 35522, 35528, 35541, 35609, 35613, 35640, 35652

35478 (CONF-800963—1) **Ribulosebisphosphate carboxylase/oxygenase: active-site characterization and partial sequence determination.** Hartman, F.C.; Fraij, B.; Norton, I.L.; Stringer, C.D. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences). 1980. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From 5. international photosynthesis congress; Kassandra-Halkidiki, Greece (7 Sep 1980).

Chemical approaches that have been applied to active-site characterization of ribulosebisphosphate carboxylase/oxygenase are reviewed. These include modification with group-specific reagents, affinity labeling, and paracatalytic modification. In an attempt to obtain reagents with a greater specificity for the enzyme's active site, two reactive derivatives (the acid azide and the 3-chloroacetyl compound) of the transition state analog 2-carboxyarabinitol 1,5-bisphosphate have been prepared. The elucidation of the primary structure of the carboxylase/oxygenase from Rhodospirillum rubrum has also been initiated. Tryptic peptides accounting for the enzyme's five sulfhydryl groups and collectively representing twenty percent of the total polypeptide chain have been sequenced. Eight major fragments resulting from cleavage of the enzyme with cyanogen bromide and representing about seventy percent of the total polypeptide chain have been purified for subsequent sequence analyses. A striking observation is the lack of detectable homology between the R. rubrum and barley enzymes based on the limited sequence data currently available.

35479 (CONF-8006122—1) **New component in protein fluorescence.** Longworth, J.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

From Conference on Luminescence from macromolecules-biological and synthetics; New York, NY, USA (16 Jun 1980).

Tryptophyl residues in proteins absorb at longer wavelengths than tyrosyl residues and thus the tryptophyl fluorescence can be selectively excited. In addition, tryptophyl residues have a fluores-

cence maximum at much longer wavelengths than tyrosyl residues and are the predominant source of fluorescence at the long wavelength region. The contribution of tyrosyl fluorescence to protein fluorescence can be determined by exploiting these spectral properties. The tyrosyl fluorescence of native human serum albumin is different than the fluorescence of N-acetyl-L-tyrosinamide. The spectral maximum is at longer wavelength and the spectral width is greater. This is caused by a second component with a maximum at 345 nm. The excitation spectrum of the 345 nm component is similar to the excitation spectrum of the normal 304 nm tyrosyl component. The 345 nm is largely absent from denatured serum albumin. An excited singlet state protolysis from the buried tyrosyl residues explains the appearance of the 345 nm component. A possible acceptor base is an amino group of buried lysyl residue.

35480 Isolation of a Ca^{2+} carrier from calf heart inner mitochondrial membrane. Jeng, A.Y.; Shamoo, A.E. (Univ. of Rochester, NY). *J. Biol. Chem.;* **255**: No. 14, 6897-6903(25 Jul 1980).

A protein has been isolated from calf heart inner mitochondrial membrane with the aid of an electron paramagnetic resonance (EPR) assay based on the relative binding properties of Ca^{2+}, Mn^{2+}, and Mg^{2+} to the protein. The molecular weight of this protein has been estimated to be about 3000 by urea/sodium dodecyl sulfate-gel electrophoresis and amino acid analysis. The isolated protein has been shown to have high affinity and high specificity for Ca^{2+}. However, the protein was found to be contaminated with a large amount of phospholipids. There are 150 mol of phospholipids associated with each mole of the protein. The protein is delipidated using Sephadex LH-20 column chromatography. The contaminating phospholipids can be reduced to 0.1 mol of phospholipids/mol of protein. There are no detectable free fatty acids, hexosamines, or sialic acids associated with the delipidated protein. This protein is named calciphorin, meaning calcium ionophore protein.

35481 (LMF—69, pp 312-314) **Fractionation and chemical analysis of a low Btu coal gasifier effluent.** Royer, R.E.; Mitchell, C.E.; Hanson, R.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Primary fractions of disengagement chamber tar separated by gel chromatography on Sephadex LH-20 vary widely in their chemical and physical properties. The fraction containing compounds with polar functional groups and nitrogen heterocycles had the most mutagenic activity in bacterial tests. Subfractionation by classical aqueous/organic partition methods showed that the barac subfraction was the most mutagenic. Further fractionation and analysis will require different methods for each fraction.

35482 (LMF—69, pp 315-319) **Evaluation of solid adsorbents for sampling organometallic compounds.** Weissman, S.H.; Rogers, J. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Fossil fuel technologies are expected to produce organometallic compounds. To identify and quantitate these organometallics, it is necessary to develop methods for sampling vapor-phase organometallics. Three solid adsorbents were studied for sampling organometallics. Experiments to date show that Tenax is the best adsorbent. Activated charcoal and XAD-2 were less desirable because of their higher capacity for retaining vapor-phase polynuclear aromatic hydrocarbons than for retaining organometallics.

35483 (LMF—69, pp 320-324) **Decomposition of Tenax-GC and XAD-2 from exposure to NO_2.** Hanson, R.L.; Carpenter, R.L.; Barr, E.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Tenax-GC and Amberlite XAD-2 are porous polymer adsorbents used to sample organic vapors in effluents of coal combustion technologies. Both polymers decompose in the presence of oxides of nitrogen which are also present in the effluent streams. In the present study we have shown that the decomposition products of Tenax-GC are large in molecular weight and do not interfere with the detection of polynuclear aromatic hydrocarbons (even as large as pyrene) adsorbed on the polymer. The NO_2-decomposition products of XAD-2, however, are of smaller molecular weight and prevent the use of this material for the detection of vapor phase organics in effluent streams.

35484 (LMF—69, pp 327-330) **Design of a fluid bed aerosol generator for animal exposures.** Carpenter, R.L.; Yerkes, K.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Data describing the aerosol generating characteristics of a 2-inch fluid bed aerosol generator were used to design a fluid bed generator with an aerosol output of 125 mg/m³ in 0.28 m³/min of air. A prototype generator was built and tested to ivestigate the validity of this approach. The aerosol generator produced 160 mg/m³ when operated in the same manner as the 2-inch generator. Addition of a suitable feed mechanism has provided a stable aerosol generator for animal exposure purposes.

35485 (LMF—69, pp 331-335) **Generation and dissolution characteristics of homogeneous condensation aerosols of benzo(a)pyrene.** Kanapilly, G.M.; Tu, K.W.; Mitchell, C.E.; Brodbeck, R.D. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Homogeneous condensation aerosols of benzo(a)pyrene (BaP) with particle sizes ranging from 0.1 to 2 μm aerodynamic diameter were produced and studied. The BaP aerosol could be produced with relatively constant mass concentration and particle size distribution for more than 5 hours. Data on the in vitro dissolution of the BaP particles in aqueous solvents and in different dissolution systems are presented. Although the organic BaP particles did not dissolve in simple aqueous solvents, the presence of proteins, surfactants or ethyl alcohol in aqueous solvents enhanced the rate of dissolution of the BaP.

35486 (LMF—69, pp 336-340) **Particle deposition in the Stoeber spiral duct centrifuge.** Hoover, M.D. (Institut fuer Aerobiologie, Grafschaft, Germany). Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This report describes a model for predicting the deposition of airborne particles in the Stoeber spiral duct centrifuge. Up to this time, no theoretical model existed because of the complexity of the geometry, fluid flow and coriolis and centrifugal accelerations in the centrifuge. Details of the fluid velocity profiles in a spinning duct were obtained by laser Doppler anemometry and dye injection studies in a dynamically similar Plexiglas model of the original Stoeber spiral duct centrifuge. There was agreement between the observed velocity profiles and the boundary layer theory of H. Ludwieg (1951). The velocity information was used in a model which moved particles through the geometry of the centrifuge under the influence of fluid drag and Coriolis and centrifugal accelerations. The model predicted the locations of particle deposition for a range of operating conditions. The skewed particle deposition patterns observed when the centrifuge was operated with an internal temperature gradient were shown to result from the increase of gas viscosity with temperature and the resulting decrease of particle settling velocity. Secondary flow was shown to improve centrifuge resolution by causing particles to be collected in compact deposits. Secondary flow also enables collection of smaller particle sizes by causing them to deposit early in the duct. The model can be applied to other centrifuge designs, as well.

35487 (LMF—69, pp 341-345) **Electrical aerosol analyzer: data reduction at high altitude or low pressure.** Yeh, H.C.; Cheng, Y.S.; Kanapilly, G.M. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The standard data reduction procedure for the Electrical Aerosol Analyzer (EAA) cannot be used to analyze data obtained at reduced pressure without introducing relatively large errors. A modified data reduction table was derived for use in analysis of data obtained at any desired reduced pressure. Precautions and adjustments necessary for making measurements at reduced pressure are discussed.

35488 (LMF—69, pp 346-349) **Theory of a screen-type diffusion battery.** Cheng, Y.S.; Yeh, H.C. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

A theoretical analysis of collection efficiency for screen-type diffusion batteries was made. The structure of stacks of screens can be approximated by a fan model of filter elements. The penetration equation was derived from the theory of diffusional deposition through a fan model filter. The theoretical equation is in good agreement with experimental data and, thus, is useful in the calibration of the instrument.

35489 (LMF—69, pp 350-354) **Experimental evaluation of a screen-type diffusion battery.** Cheng, Y.S.; Keating, J.A.; Kanapilly, G.M. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Monodisperse aerosol particles were used in an experimental evaluation of a screen-type diffusion battery. The experimental results are in agreement with a theory previously reported. The effects of deposition by interception and inertia and the effect of pressure differences on the diffusion battery calibration were evaluated. Based on the theory and the present calibration, operating conditions for the screen-type diffusion battery are extended.

35490 (LMF—69, pp 355-358) **Application of heavy-metal staining/backscattered electron imaging technique to the study of coal gasifier aerosols.** DeNee, P.B.; Carpenter, R.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This paper introduces a method which aids in the stabilization and visualization of coal gasifier aerosols by both scanning electron microscopy/backscattered electron imaging and transmission electron microscopy. The method uses heavy metal staining of the aerosols with osmium tetroxide (OsO_4) vapors. The osmium tetroxide combines with the oil droplets, increasing the atomic number and thus increasing their visibility.

35491 (LMF—69, pp 366-369) **Transport in pores: rate of adsorption of water by coal combustion fly ash.** Rothenberg, S.J.; Cheng, Y.S. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Rates of water adsorption by fly ash (at 0°C) are treated. Data for two samples of fly ash are shown to fall on a single curve. The equations developed are applicable to rate data for adsorption of nitrogen (at 77°K) by a porous catalyst. The equations may prove to be useful in modeling the rates of diffusion controlled catalysis or rates of adsorption of vapors by fly ash in stack emissions.

35492 (LMF—69, pp 370-374) **Effect of high temperature on aerosol charge state.** Yeh, H.C.; Cheng, Y.S. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Average electrostatic charges (polarity ignored) on three sizes of monodisperse fused aluminosilicate particles were measured as a function of heat treatment temperature, over the range of 45 to 1150°C. Results show that there are two charge peaks at about 600 and 1000°C, respectively. The first peak is probably due to electron emission while the second peak is attributed to positive ion emission. The initial charge state had minimal effect on the final charge state for temperatures higher than 600°C for the fused aluminosilicate particles studied.

35493 **Conformational changes in the H3.H4 histone complex.** Feldman, L. (Tufts Univ. School of Medicine, Boston, MA); Beaudette, N.V.; Stollar, B.D.; Fasman, G.D. *J. Biol. Chem.;* **255**: No. 15, 7059-7062(10 Aug 1980).

The H3.H4 complex has been extracted from calf thymus chromatin in either 0.05 M NaOAc, pH 5.0, or in 2.0 M KCl, 0.1 M KPO_4, pH 6.7, and both forms have been shown to consist solely of histones H3 and H4 when examined on sodium dodecyl sulfate-polyacrylamide gels. Serological and circular dichroism analyses indicate the existence of structural differences between the two forms. Dilution of the high salt form of the complex into low salt produces a time-dependent conformational change which is related to reduction in the α helix content of the complex and which exposes antigenic sites on the complex. The existence of multiple forms of the H3.H4 complex may be related to the dynamic equilibrium of nucleosome structure in vivo.

35494 **Mechanism of primer-template-dependent conversion of dNTP → dNMP by T5 DNA polymerase.** Das, S.K. (Univ. of Tennessee, Oak Ridge); Fujimura, R.K. Contract W-7405-ENG-26. *J. Biol. Chem.:* **255**: No. 15, 7149-7154(10 Aug 1980).

T5 DNA polymerase catalyzes both 5′ → 3′ polymerization and 3′ → 5′ hydrolysis in a processive fashion. This knowledge has been utilized to obtain evidence indicating that the enzyme has a single primer-template binding site which can function as either polymerase or exonuclease, perhaps with the cooperation of additional or different side groups. Template-dependent conversion of dNTP → dNMP was observed with an excess of either primer-template or enzyme. With primer-template excess, practically all the enzymes were functional as polymerase; with enzyme excess, all primer-templates were extended during the first cycle of catalysis. These observations suggest that turnover takes place at the points of chain growth. Evidence is also provided which demonstrates that the enzyme is capable of switching its direction of catalysis from 3′ → 5′ to 5′ → 3′ without leaving the primer-template. A clear correspondence between the relative amount of hydrolysis of a terminally labeled residue on the primer and the relative amount of turnover suggests that (a) the probability of hydrolysis of a given type of residue in contact with the active site is constant, and (b) during each turnover episode enzyme usually takes only one step in the 3′ → 5′ direction. A simple probabilistic model of turnover is discussed.

35495 **Protein rotational mobility and lipid fluidity of purified and reconstituted cytochrome c oxidase.** Swanson, M.S. (Univ. of California, Berkeley); Quintanilha, A.T.; Thomas, D.D. *J. Biol. Chem.:* **255**: No. 15, 7494-7502(10 Aug 1980).

The rotational mobility of spin-labeled bovine heart mitochondrial cytochrome c oxidase in purified form, and incorporated into lipid vesicles was studied. A rigidly attached short chain maleimide spin label permitted mobility by saturation transfer electron paramagnetic resonance. A long chain maleimide spin label was used to detect the fluidity of the lipid hydrocarbon region adjacent to the protein by conventional EPR. One method of preparing the purified enzyme resulted in a high degree of protein rotational mobility at 4°C both in the purified detergent-solubilized enzyme (effective rotational correlation time of 100 ns) and in reconstituted membranes (correlation time of 40 μs). By contrast, another purification procedure resulted in little or no submillisecond protein rotational mobility both in purified form and in reconstituted membranes, suggesting the presence of large protein aggregates. Thus, the state of aggregation of cytochrome oxidase in membranes appears to depend on the state of aggregation prior to reconstitution. The mobile and immobile enzymes had the same high activity. In both reconstituted preparations, the bulk of the lipid was quite fluid at 4°C, as probed by a free fatty acid spin label. The lipid hydrocarbon region adjacent to the protein, as probed by the long chain maleimide spin label, was also quite fluid in the membranes containing mobile enzyme,but was strongly immobilized in the membranes containing immobile enzyme. Thus, the strong immobilization of lipid in our preparations of cytochrome oxidase is apparently caused by protein-protein interactions, not by rigidity at the protein-lipid boundary.

35496 **Electrophoretic properties of a Ca^{2+} carrier isolated from calf heart inner mitochondrial membrane.** Jeng, A.Y.; Shamoo, A.E. (Univ. of Rochester, NY). *J. Biol. Chem.;* **255**: No. 14, 6904-6912(25 Jul 1980).

The requirements of lipophilic ions in the extraction of Ca^{2+} into an organic phase mediated by the delipidated calcium ionophore protein (calciphorin) have been investigated. It was found that the extraction of Ca^{2+} into an organic phase mediated by the delipidated calciphorin requires the presence of a lipophilic anion, picrate. Picrate also enhances the rate of calciphorin-mediated Ca^{2+} translocation through a bulk organic phase. The relative cation selectivity of calciphorin determined from the organic solvent extraction experiments is $Zn^{2+} > Ca^{2+}$, $Sr^{2+} > Mn^{2+}$. The delipidated calciphorin becomes more hydrophobic in the presence of Ca^{2+} and alkaline pH in the organic solvent extraction experiments. The pH profile of the mole ratio of Ca^{2+} to calciphorin exhibits a typical titration curve, showing a pK/sub a/ of 8.0 to 8.1. Ruthenium red and La^{3+} are shown to inhibit calciphorin-mediated Ca^{2+} extraction into the organic phase. The respiratory inhibitors, the mitochondrial ATPase inhibitor, and the uncoupling agent have no effect on the Ca^{2+} extraction. Phosphate does not stimulate calciphorin-mediated Ca^{2+} extraction. The Ca^{2+}.calciphorin complex appears to have two positive charges. The delipidated calciphorin only has one class of Ca^{2+}-binding sites as revealed from the flow dialysis studies. These Ca^{2+}-binding sites have a dissociation constant of 5.2 μM and bound 1 mol of Ca^{2+}/mol of calciphorin. Evidence suggests that calciphorin may be a strong candidate for the Ca^{2+} carrier responsible for the influx mechanism in the mitochondrial Ca^{2+} transport system.

35497 **Bile acid sulfates. II. Synthesis of 3-monosulfates of bile acids and their conjugates.** Tserng, K.Y.; Klein, P.D. (Argonne National Lab., IL). *Lipids;* **13**: No. 7, 479-486(1978).

Bile acid 3-monosulfates were synthesized by the sulfation of 3-hydroxy formyloxy bile acids with sulfur trioxide-triethylamine in dimethylformamide at 25 C for 0.5 h. The protecting formyl groups were then hydrolyzed under mild alkaline conditions, and the deformylated products were isolated as p-toluidinium salts. These p-toluidinium salts were converted easily to the corresponding disodium salts by methanolic sodium hydroxide. Disodium salts were then isolated by precipitation from methanol-ether. The corresponding glycine conjugates were similarly synthesized by the sulfation of ethyl esters of 3-hydroxy formyloxy bile acid glycine conjugates. However, the taurine-conjugated bile acid sulfates were obtained by conjugating bile acid 3-monosulfates, either as triethylammonium salt or as disodium salt, with taurine in dimethylformamide in the presence of N-ethoxycarbonyl-2-ethoxy-1,2-dihydroquinoline. These procedures produced the desired bile acid sulfates in high yield (typically above 90%) with minimum manipulation. No time-consuming and capacity-limited chromatographic purification was needed to isolate the pure sulfates. The thin layer chromatographic mobilities, the ir spectra, and some of the preliminary studies of the properties of these synthesized 3-monosulfates are also discussed. 3 figures, 2 tables.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 35442, 35505, 35515, 35530, 35533

35498 **Associations of erythrocyte membrane proteins: binding of purified bands 2.1 and 4.1 to spectrin.** Tyler, J.M.; Reinhardt, B.N.; Branton, D. (Harvard Univ., Cambridge, MA). Contract EY-76-S-02-2423. *J. Biol. Chem.:* **255**: No. 14, 7034-7039(25 Jul 1980).

Specific associations of spectrin with Bands 2.1 and 4.1 have been examined by measuring the binding of purified ^{125}I-Band 2.1 and ^{125}I-Band 4.1 to [^{32}P]spectrin in solution. Binding of Bands 2.1

and 4.1 to spectrin was measured as ^{125}I radioactivity precipitated by an anti-spectrin.Staphylococcus aureus complex. The association between spectrin and Band 2.1 is characterized by relatively high affinity (K/sub d/ $\simeq 10^{-7}$ M at pH 7.6) and saturation of available binding sites at a molar ratio of 1:1 (Band 2.1/spectrin heterodimer). Band 4.1 binding to spectrin is characterized by a similar affinity (K/sub d/ $\simeq 10^{-7}$ M at pH 7.6) with saturation of available sites occurring at a stoichiometric ratio of 2:1 (Band 4.1/spectrin heterodimer). Scatchard plots of Band 4.1 binding to spectrin are curvilinear and consistent with a positively cooperative interaction. Bands 2.1 and 4.1 bind to different sites on the spectrin molecule: unlabeled Band 4.1 does not competitively displace ^{125}I-Band 2.1 from spectrin in solution, and low angle rotary-shadowed platinum-carbon replicas of these polypeptides reveal two discrete binding sites.

CYTOLOGY

REFER ALSO TO CITATION(S) 35510, 35599, 35600, 35601

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 35498, 35512, 35530, 35605

GENETICS

REFER ALSO TO CITATION(S) 35523, 35539, 35594

35499 (DOE/EV/03214—T1) **Research on human genetics in Iceland. Progress report.** (Iceland Univ., Reykjavik). 31 Oct 1980. Contract AC02-76EV03214. 133p. NTIS, PC A07/MF A01.

Records of the Icelandic Population are being used to investigate the possible inheritance of disabilities and diseases as well as other characters and the effect of environment on man. The progress report of research covers the period 1977 to 1980. The investigation was begun in 1965 by the Genetical Committee of the University of Iceland and the materials used are demographic records from the year 1840 to present and various medical information. The records are being computerized and linked together to make them effective for use in hereditary studies.

35500 (DOE/EV/03941—52) **Mechanisms of recombination and function of DNA in bacteria. Progress report, August 16, 1979 to August 15, 1980.** Guild, W.R. (Duke Univ., Durham, NC (USA). Dept. of Biochemistry). 1980. Contract AS05-76EV03941. 5p. NTIS, PC A02/MF A01.

Major effort in this period has gone to (1) analysis of the process of plasmid transformation in pneumococcus, (2) continued study of resistance determinants inserted in the chromosomes of clinical strains of pneumococcus and their transfer by conjugation, a novel phenomenon, discovered last year, and (3) temperate phages of pneumococcus.

35501 **Genetic control of glycolysis in human erythrocytes.** Gilroy, T.E.; Brewer, G.J.; Sing, C.F. (Univ. of Michigan Medical School, Ann Arbor). *Genetics;* **94**: No. 3, 719-732(Mar 1980).

We have studied heritability of the concentration of each glycolytic intermediate and adenine nucleotide in the cytosol of human erythrocytes obtained from a random sample of apparently healthy young individuals. Preliminary to analysis of heritability, each trait was statistically described and the effects attributable to variation in measured concomitants were removed by regression. Heritability was estimated using the family-set method. This method removes covariances between the index case, sibling and first cousin, due to those environmental determinants of the phenotypic values that are shared with a matched, unrelated control member of the family set. It also removes covariances due to environments that are shared by siblings and first cousins. Heritability was estimated by employing the fact that the variance of differences between first cousins minus the variance of differences between full siblings estimates three-fourths of the additive genetic variance. The heritability estimates for G6P, F6P, ATP and some other metabolite concentrations are high and significantly greater than zero. The heritabilities of G6P and F6P are likely attributable to genetic variation in the in vivo activity of HK and/or PFK, because the concentrations of these metabolites are tightly controlled by the two regulatory enzymes. Statistically significant heritability estimates for HK and PFK mass action ratios stronglysuggest genes are responsible for a portion of the quantitative variation in these enzyme activities. Since HK and PFK regulate glycolysis and the production of ATP, genetic variation in their activities might be causally related to the heritability of ATP concentration.

METABOLISM

REFER ALSO TO CITATION(S) 35501, 35619, 35620, 35621, 35622

35502 **Dynamics of DDT in the terrestrial snail Otala lactea (Stylommatophora:Helicidae).** Wurzinger, K.H. (Univ. of Michigan, Ann Arbor); Dindal, D.L. Contract AT(11-1)-3474. *Malacol. Rev.;* **8**: 65-80(1975).

Seventy specimens of Otala lactea (Mueller) were fed 40 μg radiolabelled DDT.gram^{-1} body weight and analyzed by liquid scintillation spectrometry to determine the body distribution and dynamics of the DDT within the snail's tissues. More than 50% of the pesticide fed to the animals was excreted in the feces after 1 to 2 days. Residues in the body accumulated mostly in the hepatopancreas. All tissues assayed contained measureable quantities of DDT. Five patterns of residue distribution/time were apparent. Pattern I, exhibited by the buccal mass, esophagus, crop, stomach and intestine, showed a general decrease in residue concentrations over the 14 day test period. Pattern II, exhibited by the hepatopancreas, kidney, ovotestis, sperm-oviduct, albumen gland and mucous gland, showed a general increase in residue concentrations. Pattern III, exhibited by the salivary gland, spermatheca, circumesophageal nerve ring, lung, collar (mantle edge), foot and vagina + dart sac, showed a fairly constant level of residues. Pattern IV, exhibited by the retractor muscles, epidermis and heart, showed a cyclical distribution of residue levels. Pattern V, exhibited by the penis, showed a cyclical distribution of residue levels that were different from Pattern IV. A double compartment scheme was utilized to explain those trends. Period A, corresponding to the fast compartment, is due to the initial ingestionof insecticide. Periods B and C, corresponding to the slow compartment, are due to the redistribution of residues within the organism.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 35580, 35614, 35615, 35616, 35618

MEDICINE

REFER ALSO TO CITATION(S) 35537, 35646, 35647

35503 (DOE/EV/10343—T1) **Progress report, October 1, 1979-September 30, 1980.** (Vanderbilt Univ., Nashville, TN (USA). Dept. of Radiology). 30 Jul 1980. Contract AS05-80EV10343. 13p. NTIS, PC A02/MF A01.

The operations and activities of the Biomedical Computing Technology Information Center (BCTIC) for the period 8 April 1980 to 30 July 1980 are summarized. These include mailing list update, software package preparation, software implementation, quality control of software, and Society of Nuclear Medicine support. (ACR)

35504 **Plasminogen activator as a diagnostic marker for preneoplastic cells in human gynecologic specimens.** Jensen, R.H.; Bigbee, W.L.; Zimmerman, A.L.; King, E.B. (Univ. of California, Livermore). *Acta Cytol.;* **23**: No. 2, 105-113(Mar 1979).

A modified fibrin-agar overlay assay was used to measure the fibrinolytic activity in human cervical epithelial cells. The fibrinolytic activity results from a cell-associated serine protease that acts as a plasminogen activator. An enzymatic and morphologic comparison of individual normal and abnormal cells reveals that about 50% of the dysplastic and carcinoma in situ cells contain high levels of the activator. Forty percent of morphologically normal metaplastic cells also exhibit high activities of plasminogen. Forty percent of morphologically normal metaplastic cells also exhibit high activities of plasminogen activator. Most normal intermediate and superficial epithelial cells and all erythrocytes and leukocytes are inactive. The frequency of plasminogen activator-containing cells was somewhat higher in cytomorphologically abnormal samples than in normal samples.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 35442

35505 (PB—80-804156) **Radioimmunoassay studies (citations from the NTIS data base). Report for 1964-January 1980.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 162p. NTIS PC N01/MF N01.

The bibliography presents a compilation of references on the application of the radioimmunoassay test in biochemistry, clinical chemistry, immunology, microbiology, and pharmacology. (This updated bibliography contains 155 abstracts, 18 of which are new entries to the previous edition.)

EXTERNAL RADIATION IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 35356

EXTERNAL RADIATION IN THERAPY

REFER ALSO TO CITATION(S) 35769

35506 (CONF-800731—3) **Measurement of neutron and charged particle contamination in high energy medical therapy x-ray beams using recoil track registration in polycarbonate foils.** Sanders, M.E.; Morgan, K.Z.; McGinley, P.H. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering; Emory Univ. Clinic, Atlanta, GA (USA). Radiation Therapy Dept.). 1980. Contract AS05-76EV04814. 16p. NTIS, PC A02/MF A01.

From Health Physics Society meeting; Seattle, WA, USA (20 Jul 1980).

The production of photoneutrons and high-energy charged particles by betatrons and linear accelerators used in radiotherapy is measured. It is concluded there exists sufficient contamination in high-energy x-ray beams to be a consideration in certain radiotherapy situations. (ACR)

35507 **Measurement of the average energy required to create an ion pair in nitrogen by high-energy ions.** Thomas, R.H.; Lyman, J.T.; De Castro, T.M. (Univ. of California, Berkeley). *Radiat. Res.;* **82**: No. 1, 1-12(Apr 1980).

At energies above ~ 10 MeV/amu, it is expected that the average energy required to create an ion pair, anti w, in gases will be independent of mass or charge state of the ion and with increasing energy will tend toward the value for electrons, which in nitrogen is 34.6 eV. Twenty-two measurements of anti w using 250 MeV/amu $^{12}C^{6+}$ ions, 375 MeV/amu $^{20}Ne^{10+}$ ions, and 479 MeV/amu $^{40}Ar^{18+}$ ions were made and values of 36.4 +- 0.6, 35.4 +- 0.8, and 34.7 +- 0.5 eV, respectively, were obtained for nitrogen gas.

35508 **W/sub n/ and neutron kerma for methane-based tissue-equilvalent gas.** Goodman, L.J.; Coyne, J.J. (Columbia Univ., New York, NY). Contract EP-78-S-02-4733. *Radiat. Res.;* **82**: No. 1, 13-26(Apr 1980).

Homogeneous tissue-equivalent ionization chambers containing a methane-based gas mixture are widely used to determine the absorbed dose of neutrons employed in radiobiology and radiotherapy. Conversion of the measured ionization charge to the absorbed dose requires knowledge of W/sub n, the mean energy expended to form an ion pair in the gas by the initial spectra of secondary charged particles produced by the neutrons. This report discusses the computed charged particle spectra in the gas and the relative kermas contributed by the various types of charged particles. These spectra are combined with an evaluation of the available experimental data on W for the secondary particles to compute W/sub n/ as a function of neutron energy. Over the energy range of 0.1 to 20 MeV, W/sub n/ was found to vary from 32.8 to 31.0 eV, respectively, including sharp changes in W/sub n/ due to large resonances in the energy transferred to carbon and oxygen. It is recommended that the data presented be used to evaluate W/sub n/ for each neutron spectrum for which accurate dosimetry is required. A single value of 31.9 +- 0.9 eV is recommended for less demanding applications or when neutron spectra are poorly known.

35509 **Secondary electron emission from ionization of water vapor by 0.3- to 2.0-MeV He^+ and He^{2+} ions.** Toburen, L.H.; Wilson, W.E.; Popowich, R.J. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *Radiat. Res.;* **82**: No. 1, 27-44(Apr 1980).

Yields of secondary electrons (δ rays), differential in ejected electron energy and emission angle, are reported for 0.075 to 0.5 MeV/amu helium ions, both singly and doubly charged (α particles) arising from single collisions with water molecules in vapor phase. Results are compared with similar data reported previously for protons with the same velocity. We found that the bound electron of the He^+ ion effectively screens the nuclear charge for collisions at large impact distances, thereby suppressing the yield of low-energy secondaries while contributing directly to the yield of high-energy secondaries. This results in a secondary electron spectrum of higher mean energy and lower total yield for He^+ than the bare He^{2+} produces. Comparison of the yields for He^{2+} with similar data for protons indicates deviations from Z^2 scaling which occur primarily for secondary electrons ejected at small angles, and hence, close to the path of the primary ion and for electron velocities similar to the ion velocity. These results imply that the detailed structure of helium ion tracks is somewhat different from what would be predicted from a simple Z^2 scaling of proton track structure.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 34658, 34668, 34669, 35464, 35478, 35521, 35591, 35592, 35593, 35606, 35609

35510 **Genetic studies of cell fusion induced by herpes simplex virus type 1.** Read, G.S.; Person, S.; Keller, P.M. (Pennsylvania State Univ., University Park). Contract EY-76-S-02-3419. *J. Virol.;* **35**: No. 1, 105-113(Jul 1980).

Eight cell fusion-causing syn mutants were isolated from the KOS strain of herpes simplex virus type 1. Unlike the wild-type virus, the mutants produced plaques containing multinucleated cells, or syncytia. Fusion kinetics curves were established with a Coulter Counter assay for the mutants and wild-type virus in single infections of human embryonic lung (HEL) cells, for the mutants and wild-type virus in mixed infections (dominance test), and for pairs of mutants in mixed infection and proceeded with an exponential decrease in the number of small single cells. At some later time that was characteristic of the mutant, there was a significant reduction in the rate of fusion for all but possibly one of the mutants. Although the wild-type virus did not produce syncytial plaques, it did induce a small amount of fusion that stopped abruptly about 2 h after it started. These data are consistent with the hypothesis that both mutants and wild type induce an active fusion inducer and that the activity of this inducer is subsequently inhibited. The extent of fusion is apparently determined by the length of the interval during which the fusion inducer is active. That fusion is actively inhibited in wild-type infections is indicated by the observation that syn mutant-infected cells fused more readily with uninfected cells than with wild type-infected cells.

35511 **Characterization of virus produced by a lymphoma induced by inoculation of AKR MCF-247 virus.** Pedersen, F.S.; Buchhagen, D.L.; Chen, C.Y.; Hays, E.F.; Haseltine, W.A. (Harvard Medical School, Boston, MA). Contract DE-AM03-76-SF00012. *J. Virol.;* **35**: No. 1, 211-218(Jul 1980).

We report the characterization of the virus produced by a lymphoid cell line derived from a lymphoma of an AKR mouse after injection of the polytropic AKR virus MCF-247. The virus displays polytropic host range properties and is indistinguishable from MCF-247 as judged by analysis of the large RNase T_1-resistant oligonucleotides of the RNA genome. Restriction enzyme analysis of cellular DNA revealed the presence of sequences homologous to MCF-247 genomic RNA. The EcoRI cleavage fragments were characteristic of MCF-247 DNA provirus cleavage products.

35512 **Replication of Chinese hamster embryo cells transformed by temperature-sensitive T-antigen mutants of simian virus 40.** Robinson, C.C. (Univ. of Colorado, Denver); Swartzendruber, D.E.; Lehman, J.M. *J. Virol.;* **35**: No. 1, 246-248(Jul 1980).

Chinese hamster embryo cells transformed by simian virus 40 temperature-sensitive T-antigen mutants replicated when confluent at 40.5°C, regardless of the selection method, selection temperature, or virus strain used.

35513 **Sphacelaria lacustris sp. nov., a freshwater brown alga from Lake Michigan.** Schloesser, R.E.; Blum, J.L. (Univ. of Wisconsin-Milwaukee). Contract DE-AC09-76SR00819. *J. Phycol.;* **16**: No. 2, 201-207(Jun 1980).

The growth, reproduction and ultrastucture of a new freshwater phaeophyte, Sphacelaria lacustris sp. nov., are described. The plant occurs as a minute calcified thallus at 5 to 15 m depth along the western shoreline of Lake Michigan. Both freshly collected and laboratory grown plants show apical growth of erect and basal filaments, intermittent longitudinal divisions in filament segments, vegetative reproduction by propagules, numerous parietal chloroplasts and an absence of pyrenoids, characteristics of Sphacelaria. This material is separated from the only other freshwater species in the genus (S. fluviatilis Jao) at least by differences in longitudinal septation, in branching, in its propagules and in general aspect. Between this plant and marine brown algae there are essential similarities of ultrastructure of cell wall and pores, chloroplasts, mitochondria, nucleus and the production/excretion of physodes.

35514 **Bile pigments of plants.** Bennett, A.; Siegelman, H.W. (Brookhaven National Lab., Upton, NY). pp 493-520 of Porphyrins. Vol. VI. New York, NY; Academic Press, Inc. (1979).

Bile pigments are widely, if not universally, distributed in plants, where they occur covalently linked to specific proteins. They function as important photoreceptors for photosynthesis, photomorphogenesis, and many other photobiological responses. The photosynthetically active bile pigments of blue-green, red, and cryptomonad algae impart a distinctive coloration and provide a primary biochemical marker for algal systematics. The spparently ubiquitous bile pigment in plants that is responsible for photomorphogenesis and numerous other photobiological responses is phytochrome. The distribution of phytochrome ranges throughout the chlorophyll-containing plants and their albino mutants. However, there is as yet no evidence for the occurrence of phytochrome in blue-green algae. The algal bile pigments are prominent constituents in consonance with their function as a light-harvesting system for photosynthesis. Conversely, phytochrome is found only in trace amounts in plants in keeping with its role as a regulator of growth and development. In this chapter, the principal emphasis is on the algal bile pigments and

biliproteins because they have been more extensively investigated and are more readily available for study. There are several recent reviews of algal bile pigments and biliproteins. Phytochrome is considered in a more concise fashion since the information on the molecule and its mode of action is less well developed. There are several recent reviews on phytochrome which can be consulted for additional information and concepts not detailed here.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 35460, 35505

35515 Comparative study on the mechanisms of rotavirus inactivation by sodium dodecyl sulfate and ethylenediaminetetraacetate. Ward, R.L. (Sandia Labs., Albuquerque, NM); Ashley, C.S. Contract E(29-2)-3536;EPA-IAG-D6-0675. *Appl. Environ. Microbiol.;* **39**: No. 6, 1148-1153(Jun 1980).

This report describes a comparative study on the effects of the anionic detergent sodium dodecyl sulfate and the chelating agent ethylenediaminetetraacetate on purified rotavirus SA-11 particles. Both chemicals readily inactivated rotavirus at quite low concentrations and under very mild conditions. In addition, both agents modified the viral capsid and prevented the adsorption of inactivated virions to cells. Capsid damage by ethylenediaminetetraacetate caused a shift in the densities of rotavirions from about 1.35 to about 1.37 g/ml and a reduction in their sedimentation coefficients. Sodium dodcyl sulfate, on the other hand, did not detectably alter either of these physical properties of rotavirions. Both agents caused some alteration of the isoelectric points of the virions. Finally, analysis of rotavirus proteins showed that ethylenediaminetetraacetate caused the loss of two protein peaks from the electrophoretic pattern of virions but sodium dodecyl sulfate caused the loss of only one of these same protein peaks.

MORPHOLOGY

REFER ALSO TO CITATION(S) 35513, 35517

PATHOLOGY

REFER ALSO TO CITATION(S) 35541, 35582

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 35502, 35504, 35513, 35541, 35550, 35552, 35555, 35556, 35557, 35558, 35559, 35560, 35561, 35562, 35564, 35582, 35603, 35622, 35626, 35627, 35629, 35630, 35631, 35633, 35634, 35635, 35636

35516 (LBL—11170) **Kinetics of reversible-sequestration of leukocytes by the isolated perfused rat lung.** Goliaei, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 156p. NTIS, PC A08/MF A01.

Thesis.

The kinetics and morphology of sequestration and margination of rat leukocytes were studied using an isolated perfused and ventilated rat lung preparation. Whole rat blood, bone marrow suspension, or leukocyte suspensions, were used to perfuse the isolated rat lung. The lung was also perfused with latex particle suspensions and the passage of particles through the lung capillaries was studied. When a leukocyte suspension was perfused through the lung in the single-pass mode, the rate of sequestration decreased as more cells were perfused. In contrast, latex particles of a size comparable to that of leukocytes were totally stopped by the lung. When the leukocyte suspension was recirculated through the lung, cells were rapidly removed from circulation until a steady state was reached, after which no net removal of cells by the lung occurred. These results indicate that leukocytes are reversibly sequestered from circulation. The sequestered cells marginated and attached to the luminal surface of the endothelium of post-capillary venules and veins. A mathematical model was developed based on the assumption that the attachment and detachment of leukocytes to blood vessel walls follows first-order kinetics. The model correctly predicts the following characteristics of the system: (a) the kinetics of the sequestration of leukocytes by the lung; (b) the existence of a steady state when a suspension of leukocytes is recirculated through the lung; and (c) the independence of the fraction of cells remaining in circulation from the starting concentration for all values of starting concentration. (ERB)

35517 (LMF—69, pp 162-165) **Serial morphologic changes in the lungs and tracheobronchial lymph nodes of dogs after intrapulmonary immunization with sheep erythrocytes.** Bice, D.E.; Brownstein, D.G.; Rebar, A.H.; Muggenburg, B.A.; Hill, J.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Sequential histologic changes in immunized and contralateral lung lobes, and ipsilateral and contralateral tracheobronchial lymph nodes were evaluated from dogs after intrapulmonary immunization with sheep erythrocytes. Histologic evidence of an immune response in ipsilaterial tracheobronchial lymph nodes occurred 2 days after immunization and on day 5 in immunized lung lobes. Pulmonary lymphoid infiltrates appeared initially around pulmonary venules and veins. There was expansion of these infiltrates into alveolar spaces where mixed mononuclear aggregates were formed in asociation with alveolar macrophages 7 days after immunization. A similar but attenuated and delayed response occurred within contralateral control lung lobes, although mononuclear aggregates were not found. These results suggest that after intrapulmonary immunization the lung recruits circulating immunocytes produced in ipsilateral lung-associated lymph nodes as the source of specific antibody-forming cells in bronchoalveolar air spaces.

35518 (LMF—69, pp 172-176) **Effect of corticosteroids on lung immunity following localized deposition of antigen in lungs of Beagle dogs.** Harris, D.L.; Bice, D.E.; Muggenburg, B.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Inhaled toxic materials can interact with lymphoid tissues in the respiratory tract resulting in altered immune responses. To test the effect of immunosuppression on local lung airway immunity, corticosteroids were administered to Beagle dogs systemically or directly into the lung. Specific lung airways were lavaged at 5, 7, 10 and 12 days after intrapulmonary immunization with sheep red blood cell (SRBC) antigen. The antibody-forming cell (AFC) response was tested on the lymphoid cells from lung lavages and from blood using the Cunningham assay for in vitro production of antigen-specific IgM and IgG antibodies. In addition, the anti-SRBC antibody titers in lavage fluid supernates and in blood sera were quantitated. Systemic immunosuppression resulted in a significant lowering of the total number of bronchoalveolar cells recovered from immunized lung lobes with a concomitant suppression of antibody-mediated responses. In contrast, local instillation of corticosteroids at sites of antigenic challenge did not significantly alter the development of immunity in immunized lung airways. These results indicate that corticosteroids administered systemically compromise local immunity to SRBC by suppressing immune functions in the hilar lymph nodes that receive lymphatic drainage from the lung. This research supports the premise that immunologic defense to antigenic particles in the lung is initiated primarily by lymphoid cells in these hilar lymph nodes.

35519 (LMF—69, pp 266-272) **Respiratory function of rats anesthetized with halothane or pentobarbital and breathing oxygen or air.** Mauderly, J.L.; Likens, S.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The respiratory function of Fischer 344 rats was measured using either the inhalation anesthetic, halothane, or the injectable anesthetic, pentobarital, while the rats breathed either oxygen (O_2) or air, to study differences in lung function induced by anesthetic technique. Measurements included spontaneous breathing patterns, lung volumes, quasistatic lung compliance, forced expirograms and CO diffusing capacity. Halothane gave more rapid induction and recovery, better control of anesthetic depth and higher peak flow rates. Pentobarbital gave a prolonged recovery period with excess airway secretions and larger values for tidal volume, functional residual capacity and residual volume. Air breathing resulted in larger values for ventilation, CO diffusing capacity and functional residual capacity than did O_2 breathing. Although halothane is preferred for repeated respiratory function measurements, data collected using the two anesthetics are generally similar. Repeated measurements of individual rats can substantially reduce variability and enhance the statistical treatment of experimental data.

35520 (LMF—69, pp 475-478) **Respiration of unsedated Fischer 344 rats and the effect of confinement in exposure tubes.** Mauderly, J.L.; Kritchevsky, J. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Fischer 344 rats were trained to accept respiratory measurements without sedation. Respiration was measured using a nonrebreathing valve with the rats standing on a platform and during a 1 hour confinment in inhalation exposure tubes. Males had larger breathing volumes than females, but females had larger volumes per unit body weight. Fischer 344 rats had higher respiratory frequencies and larger minute volumes than the larger Long-Evans rats previously studied. Breathing patterns were altered toward a higher respiratory frequency and smaller tidal volume during exposure tube confinement. Respiratory values and body temperatures remained constant during the 1 hour tube confinement, in contrast to increasing ventilation and temperatures of Syrian hamsters studied previ-

ously. The difference between the species was thought to be related to the better fit of the rats in exposure tubes.

35521 (LMF—69, pp 483-485) **Upper respiratory tract colonization in the development of bacterial pneumonia. A model to study the toxic effects of inhaled material.** Rowatt, J.D.; Hill, J.O.; Brownstein, D.G. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Colonization of the upper respiratory tract is an important step in the pathogenesis of respiratory infection with gram negative-bacteria. To determine the effect of immunosuppression on colonization and invasion by Pseudomonas aeruginosa, groups of mice received from 25 to 300 mg cyclophosphamide/kg intraperitoneally. Three days later, mice were exposed for 48 hours to 2 x 10^7 pseudomonads/ml drinking water. Mice administered low doses (50 mg/kg) were not colonized. Mice receiving 100 mg/kg cyclophosphamide developed nonfatal nasal colonization, whereas mice administered ≧ 150 mg/kg cyclophosphamide had evidence of colonization and invasion of the nasal epithelium. This model will be used to study the pathogenesis of pseudomonas pneumonia in mice immunosuppressed with cyclophosphamide. This will lead to development of a pulmonary infectious disease model for use in studies on the effect of pre-existing disease states on the toxicity of inhaled pollutants.

35522 (LMF—69, pp 539-544) **Pulmonary collagen, elastin and hydroxylation of proline in elastin of lungs of young adult and old rats.** Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Connective tissue metabolism in aging rats was studied as a potential model of the aging human population. Lung weight, collagen turnover and content, elastin content and the hydroxylation of proline in pulmonary elastin were measured. Pulmonary elastin was extracted sequentially by autoclaving, cyanogen bromide cleavage and hot alkali extraction. The low hydroxyproline content of this elastin suggested that it was free of collagen contaminants. Old rats had less collagen turnover than young adults. This difference reflected the reduced instantaneous growth rate of the aging rat lung. The presence of a markedly increased collagen/elastin ratio in one group of aged rats was caused by both increased pulmonary collagen and reduced pulmonary elastin. The reduced pulmonary elastin was associated with increased hydroxylation of proline in pulmonary elastin. The possibility that the increased hydroxylation could have led to poorly crosslinked elastin, more rapid breakdown of elastin and less pulmonary elastin was considered. In another group of old rats, only a marginal elevation of the collagen/elastin ratio was noted, suggesting that changes in collagen/elastin ratios were a sensitive indicator of altered connective tissue metabolism.

35523 **Estimation and comparison of parameters in stochastic growth models for barn owls.** White, G.C. (Los Alamos Scientific Lab., NM); Brisbin, I.L. Jr. *Growth;* **44**: No. 2, 97-111(Jun 1980).

Alternative methods for parameter estimation and the incorporation of stochasticity into growth models are investigated and compared to the commonly used sampling error model in which error terms are simply added-on to the integrated form of growth equation. A process error model, in which the process of growth is assumed to have stochastic variation or error incorporated within it, was found to be more appropriate for use with nonlinear estimation procedures based on a minimization of $\Sigma e/\text{sub } i/^2$. The process error model tended to minimize and/or eliminate the autocorrelation of residuals, which were characteristic of the sampling error model. These analyses further suggest that while the commonly used sampling error growth model may indeed provide unbiased parameter estimates, the estimated variances of such estimates are likely to be unwarrantedly low, thus raising questions as to the validity of any statistical comparisons based on such analyses. The procedure is illustrated with growth data from captive-reared sibling nestling barn owls, using the Richards' growth curve. These analyses suggest that both growth rate and growth form are subject to a higher degree of genetic control than is asymptotic weight which showed a greater tendency to vary according to the hatching order of the nestlings.

35524 **Time-temperature conversions in biological applications of hyperthermia.** Henle, K.J.; Roti Roti, J.L. (Univ. of Utah, Salt Lake City). *Radiat. Res.;* **82**: No. 1, 138-145(Apr 1980).

The heating of cells or tissues generally involves a temperature transient during which the temperature of the heated object rises from an initial to a final level with biological effects occurring during this interval. The method proposed in this paper can estimate these effects by using the data on isobiological effects obtained both in vitro and in vivo. The method has some limitations in that it cannot be applied under conditions where the thermotolerance develops or step-down heating occurs. Several examples from both in vivo and in vitro applications serve to illustrate this method as a practical tool in hyperthermia research.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 35505, 35580, 35605, 35614, 35616, 35617, 35618, 35623, 35624, 35625, 35628, 35632

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 35537, 35544, 35545, 35554, 35583, 35644

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 34623, 35475, 35611

35525 (PB—80-110216) **Convenience foods and home-prepared foods: comparative costs, yield, and quality. Agricultural economic report (final) 1975-1978.** Traub, L.G.; Odland, D.D. (Economics, Statistics, and Cooperatives Service, Washington, DC (USA). National Economics Div.). Aug 1979. 189p. NTIS, PC A09/MF A01.

Convenience products were shown to represent about half the sales of foods purchased for consumption at home. Based on retail food prices collected from chain grocery stores in Philadelphia, Milwaukee, San Francisco-Oakland, and New Orleans, 58% of the convenience foods studied cost more per serving than their fresh or home-prepared counterparts. Most of the convenience foods studied required less time and fuel for home preparation and did not differ significantly in eating quality from their counterparts made from a home recipe.

35526 **Energy production in irrigated, intensively cultured plantations of Populus Tristis # 1 and jack pine.** Zavitkovski, J. (Forest Service, Rhinelander, WI). Contract EG-77-A-29-1094. *For. Sci.;* **25**: No. 3, 383-392(Sep 1979).

Energy budgets were prepared for irrigated, intensively cultured plantations of Populus Tristis # 1 and jack pine in northern Wisconsin. Energy inputs into biomass production (site preparation, fertilization, weed control, irrigation, and harvesting) and into material processing (chipping and drying) amounted to about 20 percent of the total energy at age 10. The available energy (after deducting energy inputs) in 10-year old plantations of P. Tristis # 1 and jack pine was 2353 and 1863 MBtu/ha, respectively, which is equivalent to the energy in 430 and 340 barrels of oil. This was 43 and 13 percent more energy than that reported for highly productive, nonirrigated, intensively cultured plantations and a naturally regenerated forest. This indicates that energy invested in irrigation brings commensurate energy returns. The available energy from forest biomass, which is negligible when compared with the total energy consumption in the United States, could be increased by a widespread application of existing agronomic technology.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

35527 (LMF—69, pp 24-29) **In vitro dissolution behavior of pure and mixed U and Pu oxide aerosols.** Kanapilly, G.M.; Mo. T.; Boecker, B.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

In vitro dissolution data in a synthetic ultrafiltrate containing DTPA (SUF + DTPA) and in 0.1 M HCl were obtained on aerosol samples of pure $^{233}UO_2$, $^{233}U_3O_8$, $^{233}UO_3$, $^{239}PuO_2$ and mixed (U-Pu)O_2 with Pu content varying from 1 to 35%. The in vitro dissolution rates of all these aerosols were faster in HCl than in SUF + DTPA. All dissolution rates were several times faster during the first 2 days than at later times. The dissolution rates of the uranium oxide aerosols in SUF + DTPA were comparable to the available in vivo data. The major significant finding of this study was that the dissolution rates of the Pu from UO_2-PuO_2 were several orders of magnitude higher than the dissolution rates of Pu from pure PuO_2 and that this increase was dependent on the U/Pu ratio in the UO_2-PuO_2 mixed particles.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

35528 DNA repair after ultraviolet irradiation of ICR 2A frog cells: pyrimidine dimers are long acting blocks to nascent DNA synthesis. Rosenstein, B.S.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Biophys. J.;* **31**: No. 2, 195-205(Aug 1980).

The ability of ICR 2A frog cells to repair DNA damage induced by ultraviolet irradiation was examined. These cells are capable of photoreactivation but are nearly totally deficient in excision repair. They have the ability to convert the small molecular weight DNA made after irradiation into large molecules but do not show an enhancement in this process when the UV dose is delivered in two separate exposures separated by a 3- or 24-h incubation. Total DNA synthesis is depressed and low molecular weight DNA continues to be synthesized during pulse-labeling as long as 48 h after irradiation. The effects of pyrimidine dimer removal through exposure of UV irradiated cells to photoreactivating light indicate that dimers act as the critical lesions blocking DNA synthesis.

35529 Sudden reversion to normal radiosensitivity to the effects of x irradiation and plutonium-238 α particles by a radioresistant rat-mouse hybrid cell line. Robertson, J.B.; Raju, M.R. (Los Alamos Scientific Lab., NM). *Radiat. Res.;* **83**: No. 1, 197-204(Jul 1980).

A radioresistant rat-mouse hybrid cell line (HD_1) evolved after a year in tissue culture into a cell line (HD/sub 1a/) that exhibited normal radiosensitivity. The D_0 of the original HD_1 cells dropped from 200 to 125 rad for HD/sub 1a/ after exposure to x rays and from 105 to 90 rad after exposure to ^{238}Pu α particles. The decrease in radioresistance in HD/sub 1a/ cells was accompanied by a decreased amount of cellular DNA and a reduction in chromosome number. There were no measurable differences in ability to repair sublethal or potential lethal damage in either cell line.

35530 Effects of x rays on DNA synthesis in synchronized Chinese hamster ovary cells. Laughlin, T.J.; Taylor, J.H. (Florida State Univ., Tallahassee). *Radiat. Res.;* **83**: No. 1, 205-209(Jul 1980).

Chinese hamster ovary cells were synchronized at the beginning of S phase with 5-fluorodeoxyuridine and irradiated with moderte levels (< 3000 rad) of x rays. The block was reversed by pulse-labeling the cells with medium containing [^{3}H]thymidine at various times after irradiation. The cells were lysed immediately after termination of the pulse, and the rate of DNA synthesis, size of the nascent strands, and number of active replicons were determined. The level of DNA synthesis in cells pulse-labeled immediately after x irradiation with 1000 rad was suppressed 20 to 25% but returned to control levels within 4 h after irradiation. Our data demonstrate that this x-ray-induced suppression of DNA synthesis was due entirely to a reduction in the number of active replicons, with no appreciable change in the rate of chain growth.

35531 Inactivation of synchronized Chinese hamster V79 cells with charged-particle track segments. Bird, R.P. (Columbia Univ., New York, NY); Rohrig, N.; Colvett, R.D.; Geard, C.R.; Marino, S.A. Contract EP-78-5-02-4733;EY-76-C-02-0016. *Radiat. Res.;* **82**: No. 2, 277-289(May 1980).

Synchronized Chinese hamster V79 cells were irradiated with protons, deuterons, and helium-3 ions in a series of cell inactivation experiments. The charged particles were accelerated at the Radiological Research Accelerator Facility at Brookhaven National Laboratory and provided a range of LET values from 10 to 170 keV/μm. Two parts of the cell cycle were irradiated to determine clonogenic survival, the G_1/S transition and late-S phase, both obtained by hydroxyurea-induced synchrony. The difference in radiation sensitivity between these two synchronized cell populations decreased with increased values of LET, but a 10-fold difference persisted with the highest LET values. The inactivation cross sections calculated from initial slopes of the survival curves increased to plateau values of about 19 and 38 μm^2 for the late-S and G_1/S cells, respectively. In contrast, the respective cross sections of cell nuclei were measured and had mean values of 222 and 165 μm^2.

35532 Cysteamine as a protective agent with high-LET radiations. Bird, R.P. (Columbia Univ., New York, NY). Contract EP-78-5-02-4733;EY-76-C-02-0016. *Radiat. Res.;* **82**: No. 2, 290-296(May 1980).

Experiments to measure the radiation protection of cysteamine for high-LET radiations were carried out with synchronized Chinese hamster V79 cells. A high concentration (75 mM) of cysteamine was found to provide protection against x rays and 90 and 170 keV/μm helium ions. The extent of protection decreased with increased LET value but was substantial with the highest-LET radiation. Thus the approximate dose-modifying factor for G_1/S cells was decreased from 4.8 to 1.6 and for late-S cells from 3.2 to 1.5. The shape of the high-LET survival curves for both cell cycle times was preserved as expected for a dose-modifying agent.

INTERNAL SOURCE

REFER ALSO TO CITATION(S) 35529

35533 Investigation of the effect of radioactive labeling of DNA on excision repair in uv-irradiated human fibroblasts. Ehmann, U.K.; Friedberg, E.C. (Stanford Univ., CA). *Biophys. J.;* **31**: No. 2, 285-291(Aug 1980).

Previous studies on the kinetics of thymine dimer excision and unscheduled DNA synthesis in uv-irradiated human fibroblasts showed a significant discrepancy in these two parameters. In the present study we have investigated the effect of the level of the radioactive isotope used for labeling cells on the kinetics of a parameter that indirectly measures thymine dimer excision. We find no significant differences in the kinetics of this parameter in cells lightly or heavily labeled with radioactive thymidine.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

35534 Comparison of repair rates determined by split-dose and dose-rate methods. Braby, L.A.; Nelson, J.M.; Roesch, W.C. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *Radiat. Res.;* **82**: No. 1, 211-214(Apr 1980).

Both split-dose and dose-rate techniques have been used to investigate sublethal damage repair in Chlamydomonas reinhardi irradiated with fast electrons. Repair rates, measured by these two methods, were found to depend on temperature over the range 7.5 to 32.5°C. However, no significant differences were found between values determined by the two methods.

RADIATION EFFECTS ON ANIMALS

MAN

35535 (LBL—11268) BEIR-III controverly. Fabrikant, J.I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., San Francisco (USA). School of Medicine). Jun 1980. Contract W-7405-ENG-48. 27p. (CONF-8006118—1). NTIS, PC A03/MF A01.

From 28. annual scientific meeting of the radiation research society; New Orleans, LA, USA (1 Jun 1980).

How certain of the areas addressed by the Committee on the Biological Effects of Ionizing Radiation (BEIR) have attempted to deal with the scientific basis for establishing appropriate radiation protection guides is discussed, and what effect this may have on decision-making for the regulation of societal activities concerned with the health effects in human populations exposed to low-level radiation. (ACR)

35536 (PB—80-119852) Estimate of the cancer risk due to nuclear-electric power generation. Technical note. Ellett, W.H.M.; Richardson, A.C.B. (Office of Radiation Programs, Washington, DC (USA). Div. of Criteria and Standards). Oct 1976. 42p. NTIS, PC A03/MF A01.

The report considers the risk of fatal cancer for the entire fuel cycle due to radiation exposure associated with the annual production of one gigawatt (1000 megawatts) of nuclear electric power. Three sources of radiation exposure are examined: (1) occupational exposure to radiation workers; (2) exposure of the general population from routine releases of radioactivity to the environment; and (3) exposure due to accidental releases of radioactivity. In the analysis, exposures to radiation due to uranium fuel cycle are projected for a period of 100 years following the production of electricity. The major potential impact on human health is from radionuclides intentionally released into the environment during the milling of ores and at fuel reprocessing. It is estimated that about one cancer death could be committed for each gigawatt-year of electrical energy produced.

35537 (PB—80-126329) Bureau of Radiological Health publications subject index. Semiannual report, April-October 1979. (Bureau of Radiological Health, Rockville, MD (USA)). Oct 1979. 18p. NTIS, PC A02/MF A01.

The Subject Index identifies Bureau publications by broad subject areas and is not intended to be a complete cross index containing name of author, data of publication, and other such biographical information. In nearly all cases the publications are numbered in the FDA publication series consisting of the FDA acronym, a 2 digit code for the fiscal year of publication, and a 4 digit code for the individual publication number.

35538 (PNL-SA—8438) Evaluation of several methods for assessing the effects of occupational exposure to radiation. Gilbert, E.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1980.

Contract AC06-76RL01830. 28p. (CONF-800820—11). NTIS, PC A03/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

The evaluation of health effects in populations occupationally exposed to low-level ionizing radiation is a matter of considerable current controversy. The analysis of data on such exposures presents a variety of problems resulting from the time dependent nature of the exposure data, certain selective biases found in working populations, and particularly limits imposed by the size of the populations, and the magnitudes of exposures received. In this paper, several methods of analysis are presented and evaluated using data from the Hanford plant for illustration. Questions of interest include whether or not to utilize an external control, and how to handle the highly skewed exposure data most effectively. Expressions for the power of various procedures are used not only to compare methods but also to evaluate the potential for detecting effects in occupationally exposed populations.

35539 Estimation of whole-body doses by means of chromosome aberrations observed in survivors of the Hiroshima A-bomb. Randolph, M.L.; Brewen, J.G. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Radiat. Res.;* **82**: No. 2, 393-407(May 1980).

In light of recent reports whole-body doses to survivors of the Hiroshima bomb have been estimated from their symmetrical and asymmetrical chromosome aberrations. Comparisons with physically based dose estimates indicate general agreement to within a factor of less than 2. Uncertainties in the chromosome dosimetry are evaluated and discussed. Our results tend to justify use of the Hiroshima data on leukemia incidence versus acute doses as a basis for setting limits for low-intensity radiation exposures.

VERTEBRATES

35540 (CONF-800601—3) **Problems and solutions in the estimation of genetic risks from radiation and chemicals.** Russell, W.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

From 13. Rochester international conference on environmental toxicity--measurement of risks; Rochester, NY, USA (2 Jun 1980).

Extensive investigations with mice on the effects of various physical and biological factors, such as dose rate, sex and cell stage, on radiation-induced mutation have provided an evaluation of the genetics hazards of radiation in man. The mutational results obtained in both sexes with progressive lowering of the radiation dose rate have permitted estimation of the mutation frequency expected under the low-level radiation conditions of most human exposure. Supplementing the studies on mutation frequency are investigations on the phenotypic effects of mutations in mice, particularly anatomical disorders of the skeleton, which allow an estimation of the degree of human handicap associated with the occurrence of parallel defects in man. Estimation of the genetic risk from chemical mutagens is much more difficult, and the research is much less advanced. Results on transmitted mutations in mice indicate a poor correlation with mutation induction in non-mammalian organisms.

35541 (UR—3490-1900) **Effect of ionizing radiations on connective tissue.** Altman, K.I.; Gerber, G.B. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics; Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1980. Contract AC02-76EV03490. 137p. NTIS, PC A07/MF A01.

The effects of ionizing radiations on connective tissue in lung, heart, vasculature, kidney, skin, and skeletal tissues are reviewed. Special emphasis is given to the effect of ionizing radiations on vasculo-connective tissue and fibrotic changes following radiation-induced injury to organs and tissues. In order to put the subject matter in proper prospective, the general biochemistry, physiology, and pathology of connective tissue is reviewed briefly together with the participation of connective tissue in disease. The review closes with an assessment of future problems and an enumeration and discussion of important, as yet unanswered questions.

35542 Effects of split doses of x rays or neutrons on lung tumor formation in RFM mice. Ullrich, R.L. (Oak Ridge National Lab., TN). *Radiat. Res.;* **83**: No. 1, 138-145(Jul 1980).

The effect of localized thoracic doses of x rays of fission neutrons delivered either as single doses or two equal doses separated by 24-h or 30-day intervals on lung tumor formation in RFM mice was examined. Animals were killed 9 months after localized irradiation, their lungs were cleared, and the tumors were counted to determine both percentage incidence and tumors/mouse. After x irradiation, recovey was observed during the 24-h fractionation interval only when the total dose was on the dose-squared region of the dose-response curve obtained with single doses. At lower doses no effect (recovery or enhancement) was observed when the dose was split. Further, no significant increase in the split-dose effect was obtained by increasing the interval between doses from 24 h to 30 days. After neutron irradiation, no efect of splitting the dose was observed at any dose, whether the interval between doses was 24 h or 30 days. These data suggest that the primary mechanisms involved in the development of these tumors and in recovery are intracellular in nature and not influenced by intercellular interactions.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 35553, 35575

35543 (LMF—69) **Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.** Henderson, R.F.; Diel, J.H.; Martinez, B.S. (eds.). (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA)). Dec 1979. Contract AC04-76EV01013. 742p. NTIS, PC A99/MF A01.

Research information is given by the annual report from the Inhalation Toxicology Research Institute with abstracts for each of the 109 papers. Major sections of interest are nuclear energy toxicology, solar energy toxicology, diesel technology toxicology, coal technology toxicology, and conservation technology toxicology. Also included are seven appendices covering publications of technical reports and publications in open literature, abstracts publications in the open literature, seminars presented by visiting scientists and presentations before scientific meetings, organization of the Inhalation Toxicology Research Institute, and the status of experiments using beagle dogs. (DLS)

35544 (LMF—69, pp 107-110) **New dose-response model for estimating lifetime tumor risks.** Scott, B.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

A new tumorgenesis model is described in which damage to a single intracellular locus can lead to a tumorgenic cellular transformation. Assuming a large number of independent intracellular loci to be at risk and assuming that damage to locus sufficient to cause a tumorgenic transformation occurs with probability greater than zero for all doses greater than zero leads to the use of the Weibull distribution to characterize the probability of a tumorgenic cellular transformation occurring after exposure to a given dose of carcinogen. The increase in the lifetime tumor incidence above the spontaneous incidence is charactered by a tumor incidence function that represents the probability of occurrence of one or more tumorgenic cellular transformations among N(D) independent surviving cells per individual, after exposure to a dose D of carcinogen. The tumor incidence function is fitted to data for the displacement of the tumor incidence above the control incidence after exposure of humans to ^{226}Ra and ^{228}Ra, after long-term oral exposure of animals to dieldrin or dimethylnitrosamine and after long-term inhalation exposure of animals to vinyl chloride.

35545 (LMF—69, pp 111-114) **Nonparametric methods of analysis of monotonically increasing dose-response probabilities.** Scott, B.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Three nonparametric methods are presented for generating response-probability estimates and probability-density estimates after long-term exposure of individuals to toxic agents (e.g., radiation or chemical carcinogens). These methods are for cases where the response probability increases monotonically as dose increases since the methods produce estimates of the cumulative distribution function. Most presently available methods of analysis of response probabilities for induced responses utilize parametric or curve-fittiong procedures. Analysis such as minimum chi-square or maximum likelihood is often conducted to select the distribution that best represents the observations. An assumed distribution is advantageous if it is correct or if it represents a good approximation to the true distribution, otherwise nonparametric methods may be preferable. The nonparametric methods described in this paper provide point estimates of the response probability in cases where suitable parametric assumptions cannot be made. The resultant point estimates can then be used to develop or select an appropriate distribution. With these nonparametric methods, the analysis can be based on data for individuals rather than grouped data and it is unnecessary for the sample to be complete. Of the three methods described, only one is based on the maximum likelihood of hazard and therefore may be preferable. Additional studies are necessary to further develop and compare these methods.

ANIMALS

REFER ALSO TO CITATION(S) 35563, 35564, 35565, 35566, 35567, 35568, 35569, 35570, 35571, 35572, 35573, 35574, 35576, 35577, 35578

35546 (LMF—69, pp 83-91) **Toxicity of ^{144}Ce inhaled in a relatively insoluble form by Beagle dogs. XII.** Hahn, F.F.; Muggenburg, B.A.; Boecker, B.B.; Mauderly, J.L.; McClellan, R.O.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The metabolism, dosimetry and effects of ^{144}Ce inhaled in fused aluminosilicate particles are being investigated in the Beagle dog to assess the biological consequences of release of relatively insoluble aerosol forms of ^{144}Ce that could occur in nuclear accidents. The effects which result from the relatively protracted radiation dose pattern to the lung from this form of ^{144}Ce are being compared with effects of other radiation dose patterns to the lung. One hundred eleven dogs were exposed to aerosols of ^{144}Ce in fused aluminosilicate particles to yield initial lung burdens of 0.0024 to 210 μCi/kg body weight and 15 control dogs were exposed to nonradioactive fused aluminosilicate particles. To date, 59 dogs have died or were euthanized at 143 to 4179 days after inhalation of ^{144}Ce. The prominent findings were radiation pneumonitis in 17 dogs that died at early times and neoplastic disease in 35 of the 42 dogs that died 750 days or later. Primary lung tumors have been the most frequently observed neoplasms. However, tumors of other organs have been noted, primarily hemangiosarcomas. Of special interest are primary tumors of the tracheobronchial lymph nodes. The findings indicate that under local, high-dose beta irradiation, the tracheobronchial lymph nodes can be the site of neoplasia after inhalation of radioactive materials.

35547 (LMF—69, pp 101-106) **Toxicity of ^{90}Sr inhaled in a relatively insoluble form by Beagle dogs. X.** Snipes, M.B.; Hahn, F.F.; Muggenburg, B,A.; Mauderly, J.L.; McClellan, R.O.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Beagle dogs were exposed by inhalation to ^{90}Sr in a relatively insoluble form to study long-term effects of the exposure. Lung burdens ranged from 0.12 to 94 μCe ^{90}Sr/kg of body weight. Effects to date indicate that high levels of exposure yield pulmonary fibrosis and radiation pneumonitis; lower level exposures yield long-term effects which include tumors in the respiratory tract, heart, thoracic lymph nodes, ribs and mediastinum. Also, dogs are reaching old age where age becomes an additional factor in their development of medical problems which lead to death for reasons not related to the radiation exposure. An analysis of the effect of radiation on lung clearance was done. Results indicated no effect on clearance due to lung burden of ^{90}Sr and retention half-time averaged 490 days, with a standard deviation of 320 days.

35548 (LMF—69, pp 182-186) **Biological effects of repeated inhalation exposure of Beagle dogs to relatively insoluble aerosols of ^{144}Ce. VI.** Boecker, B.B.; Hahn, F.F.; Muggenburg, B.A.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Beagle dogs were exposed repeatedly to a relatively insoluble form of ^{144}Ce (in fused aluminosilicate particles) to study the deposition, retention and long-term biological effects for comparison with data from dogs that were exposed only once to a similar aerosol. Four groups of nine dogs each were exposed once every 8 weeks for 2 years (13 exposures) to achieve specified exposure goals. These goals were: to increase the lung burden by 2.5 μCi ^{144}Ce/kg body weight with each exposure; to reestablish lung burdens of 9 or 4.5 μCi ^{144}Ce/kg body weight and to expose controls to fused aluminosilicate particles containing nonradioactive cerium. With these exposure sequences, the ^{144}Ce-exposed dogs received increasing or relatively constant beta radiation dose rates in contrast to the steadily decreasing dose rate seen after a single inhalation exposure. Following completion of the exposure series, the dogs are being observed for the development of long-term biological effects. To date, 11 dogs have died or were euthanized, nine exposed dogs and two controls. Although pulmonary hemangiosarcomas were a prominent finding in dogs exposed once to the same aerosol at a level that led to cumulative doses to lung similar to these repeatedly exposed dogs, only one has been observed in the repeatedly exposed dogs. Other effects of note to date include three pulmonary carcinomas, two hemangiosarcomas of the tracheobronchial lymph nodes and one splenic hemangiosarcoma. Observations are continuing on the surviving 18 exposed and seven control dogs.

35549 (LMF—69, pp 187-192) **Repeated inhalation exposure of rats to aerosols of $^{144}CeO_2$. III.** Lundgren, D.L.; Hahn, F.F.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The effects of protracted beta radiation of the lungs of gnotobiotic female and male Fischer 344 rats are being studied. Rats were exposed seven times at 60-day intervals by inhalation to aerosols of $^{144}CeO_2$ to reestablish lung burdens of 0.04, 0.20, 1.0 or 5.0 μCi of ^{144}Ce. The observations in these rats are being compared with those in rats expose once to $^{144}CeO_2$ to achieve similar initial lung burdens of ^{144}Ce when either 84 or 500 days of age. The life spans were decreased only in the male and female rats in which a lung burden of 5.0 μCi was re-established and in male rats exposed once to achieve a similar lung burden. Survival of the rats in this study is similar to or longer than that reported elsewhere. Observations of ^{144}Ce retention and pathological changes in tissues are continuing.

35550 Microdistribution and retention of injected ^{239}Pu on trabecular bone surfaces of the beagle: implications for the induction of osteosarcoma. Wronski, T.J.; Smith, J.M.; Jee, W.S.S. (Univ. of Utah, Salt Lake City). *Radiat. Res.;* **83**: No. 1, 74-89(Jul 1980).

A study was initiated to investigate the relationship between skeletal remodeling and the microdistribution and retention of ^{239}Pu on trabecular bone surfaces of the beagle, and the contribution of these parameters to the nonuniform skeletal distribution of ^{239}Pu-induced osteosarcomas. Young adult beagles were administered single iv injections of $\sim$ 0.016 μCi/kg monomeric ^{239}Pu citrate and sacrificed at various times to 1 year after injection. The ^{239}Pu concentration on trabecular bone surfaces was determined by counting fission fragment tracks in neutron-induced autoradiographs produced from thick ($\sim$ 400 μm) bone sections. The rate of trabecular bone formation was calculated from an ultraviolet microscopic analysis of fluorescent tetracycline labels. The lumbar vertebra, pelvis, and proximal humerus, each of which exhibits a high incidence of ^{239}Pu-induced osteosarcoma, were found to have a high intial concentration of ^{239}Pu on their trabecular surfaces ($\sim$ 7-8 pCi/cm^2) and a relatively high rate of trabecular bone formation. The ^{239}Pu concentration at these sites decreased to $\sim$ 2-3 pCi/cm^2 at the end of the first year. On the other hand, the proximal ulna and distal humerus, skeletal sites with a low tumor incidence, had a low intial concentration of ^{239}Pu on their trabecular surfaces($\sim$ 1-2 pCi/cm^2) and a significantly lower rate of trabecular bone formation ($P < 0.01$). The ^{239}Pu concentration at these sites remained nearly constant throughout the experimental period. These data suggest that the degree of the initial deposition of ^{239}Pu on trabecular bone surfaces and the rate of trabecular bone turnover may play a role in the genesis of ^{239}Pu-induced osteosarcomas.

35551 Repeated inhalation exposure of mice to $^{144}CeO_2$. Hahn, F.F.; Lundgren, D.L.; McClellan, R.O. (Inhalation Toxicology Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *Radiat. Res.;* **82**: No. 1, 123-137(Apr 1980).

Groups of mice (C57B1/6J strain) were repeatedly exposed by inhalation to aerosols of $^{144}CeO_2$ at 60-day intervals for seven consecutive exposures to reestablish lung burdens of ^{144}Ce of 0.2, 1.0 or 4.5 μCi. Additional groups of mice were exposed only once when 70 days old to achieve desired initial lung burdens of 0.2, 1.0, or 4.5 μCi. Control mice consisted of those exposed once or repeatedly to stable CeO_2, sham-exposed once or repeatedly, and unexposed mice. Protraction of the absorbed radiation dose by repeated inhalation exposures resulted in a sparing from the life-shortening effects of ^{144}Ce pulmonary irradiation. The protraction of dose had no effect on the total number of lung tumors seen or their time of onset. The total incidence of lung tumors, benign and malignant, was correlated with cumulative dose, not dose rate.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 35543

35552 (LMF—69, pp 34-38) **Simulation of the dosimetry of ^{232}U after inhalation in insoluble particles.** Griffith, W.C.; Cuddihy, R.G.; Hoover, M.D.; Stalnaker, N.D. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Possible radionuclide retention patterns were simulated to estimate the doses received by internal organs of humans exposed to UO_2 and ThO_2 particles containing ^{232}U. Lung clearance of the radionuclides was simulated as being composed of competitive processes including mechanical clearance of particles to the gastrointestinal tract, dissolution of particles, recoil emanation of daughter products produced by alpha-particle decay, and diffusion of ^{220}Rn from particles. It was assumed that radionuclides of the ^{232}U decay chain dissolving from the particles or recoiling out of the particle were excreted or absorbed into the systemic circulation and translocated to other organs. The simulated retention patterns of the radionuclides were used to estimate dose commitments to organs. Results of a sensitivity analysis showed that the organs receiving the largest doses depended mainly on the recoil range of the alpha-emitting daughters, mass median diameter of the aerosol, and rate of dissolution of particles. Determination of these parameters will be important in evaluation of health risks from inhalation exposures to particles containing ^{232}U.

35553 (PNL—3180) **Assessment of effectiveness of geologic isolation systems. ARRRG and FOOD: computer programs for calculating radiation dose to man from radionuclides in the environment.** Napier, B.A.; Roswell, R.L.; Kennedy, W.E. Jr.; Strenge, D.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 203p. NTIS, PC A10/MF A01.

The computer programs ARRRG and FOOD were written to facilitate the calculation of internal radiation doses to man from the radionuclides in the environment and external radiation doses from radionuclides in the environment. Using ARRRG, radiation doses to man may be calculated for radionuclides released to bodies of water from which people might obtain fish, other aquatic foods, or drinking water, and in which they might fish, swim or boat. With the FOOD program, radiation doses to man may be calculated from deposition on farm or garden soil and crops during either an atmospheric or water release of radionuclides. Deposition may be either directly from the air or from irrigation water. Fifteen crop or animal product pathways may be chosen. ARRAG and FOOD doses may be calculated for either a maximum-exposed individual or for a population group. Doses calculated are a one-year dose and a committed dose from one year of exposure. The exposure is usually considered as chronic; however, equations are included to calculate dose and dose commitment from acute (one-time) exposure. The equations for calculating internal dose and dose commitment are derived from those given by the International Commission on Radiological Protection (ICRP) for body burdens and Maximum Permissible Concentration (MPC) of each radionuclide. The radiation doses from external exposure to contaminated farm fields or shorelines are calculated assuming an infinite flat plane source of radionuclides. A factor of two is included for surface roughness. A modifying factor to compensate for finite extent is included in the shoreline calculations.

35554 **Fallout plutonium in human tissues from New York City.** Fisenne, I.M. (Dept. of Energy, New York, NY); Cohen, N.; Neton, J.W.; Perry, P. *Radiat. Res.;* **83**: No. 1, 162-168(Jul 1980).

Fallout ^{239,240}Pu concentrations were measured in lung, liver, kidney, vertebrae, and lymph nodes obtained at autopsy during 1973 to 1974 from New York City residents. For the study population, the fallout plutonium tissue concentrations in descending order were liver > bone > lymph node > lung > kidney with median concentrations of 0.37, 0.25, 0.11, 0.06, and 0.05 pCi/kg, respectively.

ANIMALS

REFER ALSO TO CITATION(S) 35546, 35547, 35548, 35549

35555 **Absorption of diethylenetriaminepentaacetic acid (DTPA) from the respiratory tracts of beagle dogs.** Dudley, R.E.; Muggenburg, B.A.; Cuddihy, R.G.; McClellan, R.O. (Inhalation Toxicology Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *Am. Ind. Hyg. Assoc. J.;* **41**: No. 1, 5-11(Jan 1980).

Absorption of diethylenetriaminepentaacetic acid (DTPA) from the nasopharyngeal (NP), tracheobronchial (TB) and pulmonary (P) regions of beagle dogs was determined because of the current interest in aerosolized DTPA as a method for the removal of radionuclides deposited in the respiratory tract. Radiolabeled DTPA was instilled into the NP, TB and P regions of dogs and its subsequent translocation was followed for 48 hours. Results revealed that 16, 48 and 90% of the instilled DTPA was absorbed into the circulatory system from the NP, TB and P regions, respectively. A comparison was also made between NP absorption of aerosolized as opposed to instilled DTPA. Nasopharyngeal absorption (23%) of aerosolized DTPA was slightly higher than that of instilled DTPA. Further, DTPA deposited in the respiratory tract remained in the body longer than intravenously injected DTPA. These findings indicate that a substantial quantity of DTPA is absorbed from all regions of the respiratory tract and that DTPA need not be deposited within the deep lung to produce systemic absorption of DTPA for the removal of internally deposited radioactive isotopes.

35556 (LMF—69, pp 5-8) **Spatial and temporal distribution of PuO_2 aerosol particles deposited in rodent lungs by inhalation.** Diel, J.H.; Mewhinney, J.A.; Snipes, M.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Alpha particles emitted from a PuO_2 particle in deep lung deposit their radiation dose in the region immediately surrounding the particle. Thus, the effects of these particles are determined by their local distribution in the lung as a function of time after inhalation. In Syrian hamsters, inhaled $^{238}PuO_2$ particles of 0.8 μm AD deposited preferentically in the central regions of the lung. With time, the relative concentration increased near the edge of the lung while decreasing in regions containing bronchial epithelium. These particles fragmented with time resulting in a slightly more diffuse irradiation of the lung and rapid translocation to other tissues.

35557 (LMF—69, pp 9-13) **Radiation dose patterns in Beagle dogs following inhalation of monodisperse and polydisperse aerosols of $^{238}PuO_2$. IV.** Mewhinney, J.A.; Diel, J.H.; Guilmette, R.A.; Merickel, B.S.; Muggenburg, B.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The radiation dose patterns in organs and tissues of the Beagle dog are being determined after inhalation of monodisperse or polydisperse aerosols of $^{238}PuO_2$. Aerosols employed in the study were 0.7, 1.4 and 2.7 μm aerodynamic diameter monodisperse aerosols and a 1.4 μm activity median aerodynamic diameter polydisperse aerosol. Twenty-six Beagle dogs received inhalation exposure to each aerosol to achieve initial lung burdens of 0.07 μCi/kg body weight. Dogs were sacrificed in pairs at selected times after inhalation exposure. Excreta collections were performed periodically on all animals. Analysis of excreta samples and tissue samples from all animals through 2 years after inhalation is complete. A distinct change in the lung retention occurred between 64 and 128 days after the inhalation exposure. This resulted in decreased pulmonary retention and increased rates of uptake by liver and skeleton. Fragmentation of the $^{238}PuO_2$ particles may be responsible for the behavior.

35558 (LMF—69, pp 14-17) **Disposition of inhaled monodisperse and polydisperse $^{239}PuO_2$ in dogs. II.** Guilmette, R.A.; Diel, J.H.; Muggenburg, B.A.; Merickel, B.S.; Mewhinney, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The temporal pattern of radiation dose to tissues of Beagle dogs which have inhaled $^{239}PuO_2$ aerosols is being studied. Each of 26 dogs received a single inhalation exposure (0.07 μCi/kg body weight) to one of the following $^{239}PuO_2$ aerosols: 0.7, 1.4 or 2.85 μm aerodynamic diameter monodisperse aerosol or 1.1 μm activity median aerodynamic diameter polydisperse aerosol. Sacrifices of male and female pairs of dogs are being performed from 4 hours to 8 years after exposure. Radiochemical analysis of Pu in dog tissues and urine and feces samples are conducted to establish the temporal behavior of inhaled $^{239}PuO_2$. In addition, in vitro dissolution studies are being performed to supplement the biological data on the in vivo solubility of $^{239}PuO_2$. The biological distribution of inhaled PuO_2 to 1 year after exposure, as well as the in vitro dissolution characteristics of $^{239}PuO_2$, has affirmed the insolubility of the inhaled material. More than 99% of the Pu in the body at sacrifice could be accounted for in lung and tracheobronchial lymph nodes at 1 year, regardless of particle size. These data are consistent with dissolution half-times of $> 10^4$ days in 0.1 M HCl.

35559 (LMF—69, pp 30-33) **Preliminary observations of the effects of elastase-induced emphysema on the deposition and retention of ^{239}Pu in rats exposed by inhalation to $^{239}PuO_2$.** Lundgren, D.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The biological effects of inhaled $^{239}PuO_2$ are being studied in Fischer-344 rats with pre-existing lung disease. Emphysema was experimentally induced in rats by intratracheal injection of elastase. The presence of emphysema in the elastase-treated rats was confirmed by the killing of representative rats and determining the mean linear intercept of alveolar walls, the fixed lung volume, and by microscopic observations of alveolar wall destruction. Six months after elastase instillation, the elastase-treated and control rats were simultaneously exposed by inhalation to an aerosol of ^{169}Yb-labeled $^{239}PuO_2$. The initial lung burdens of ^{239}Pu, as estimated both from rats sacrificed on day 0 and by the extrapolation of ^{169}Yb counting data, were less in the elastase-treated rats than in the control rats. Two-component exponential functions were fitted to the estimated lung retention of ^{239}Pu. The retention half-times of both components were greater in the elastase-treated rats than in the control rats through 90 days after exposure to ^{239}Pu.

35560 (LMF—69, pp 39-42) **Dose patterns of $^{106}RuO_4$ inhaled by the Beagle dog.** Snipes, M.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Radioruthenium tetroxide is a possible hazard to man because of its energetic beta emissions and high potential for release to the atmosphere as a result of nuclear accidents involving fission products. This study was done to develop information useful in predicting the consequences for man exposed to $^{106}RuO_4$. Data for deposition and retention patterns, excreta contents of ^{106}Ru after inhalation exposure and tissue contents of ^{106}Ru were determined to 512 days after inhalation exposure in Beagle dogs. Ninety-nine percent of the initial body burden of ^{106}Ru was rapidly cleared, with an effective half-time of 1.2 days; 0.7 and 0.3% were cleared with half-times of 14 and 170 days, respectively. Most of the ^{106}Ru ws initially associated with the upper respiratory tract. Organs and tissues at greatest risk from this exposure were turbinates, lung and liver. Gastrointestinal absorption of ingested $^{106}RuO_2$ was less than 0.3%. Data are being used to model radiation dose patterns for man exposed to this material.

35561 (LMF—69, pp 43-48) **Deposition, retention and dosimetry of inhaled ^{106}Ru attached to inert particles.** Snipes, M.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Fischer 344 rats were exposed to $^{106}RuO_4$ mixed with 0.82 μm inert particles to determine the distribution and dose patterns for this exposure atmosphere. Whole-body, tissue distribution, in vitro dissolution and excreta counting data were collected during this 96-day study. Results indicated that $^{106}RuO_4$ reacted with the particles to yield a lung burden of ^{106}Ru attached to particles. Ninety-two percent of the body burden was retained with an effective half-time of 0.7 days; the other 8% was retained with a half-time of approximately 30 days. Almost 5% of the initial burden was in the deep lung. Dissolution half-time for the ^{106}Ru from the particles was 50 to 100 days after an early rapid dissolution phase which had half-times of approximately 1 day. Dissolved ^{106}Ru entered the bloodstream and was distributed in the body in a manner similar to that observed for other forms of radioruthenium. Results are being used to model the consequences for man inhaling a similar exposure atmosphere.

35562 (LMF—69, pp 51-56) **Toxicity studies of inhaled beta-emitting radionuclides - status report.** Hahn, F.F.; McClellan, R.O.; Boecker, B.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

An experimental approach to evaluating the toxicity of inhaled beta-emitting radionuclides in laboratory animals is described. These radionuclides are being studied in aerosol forms which are either relatively soluble ($^{90}SrCl_2$, $^{144}CeCl_3$, $^{91}YCl_3$ or $^{137}CsCl$) or relatively insoluble (^{90}Y, ^{91}Y, ^{144}Ce or ^{90}Sr in fused aluminosilicate particles). Initial lung or whole-body radionuclide burdens were selected to result in early deaths due to severe lesions at the highest exposure levels, and more subtle changes, such as neoplasia, at the lower levels. The organs affected depend on the solubility and chemical characteristics of the isotope. In all experiments, emphasis is placed on an evaluation of the influence of radiation dose rate and total dose on the resulting dose-response relationship. These studies with young adult dogs are complemented with comparable studies in other species (mice, rats and Syrian hamsters) and with animals of different ages (immature, aged).

35563 (LMF—69, pp 57-61) **Toxicity of inhaled $^{90}SrCl_2$ in Beagle dogs. XIII.** Muggenburg, B.A.; Hahn, F.F.; Boecker, B.B.; Jones, R.K.; McClellan, R.O.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The metabolism, dosimetry and biological effects of inhaled $^{90}SrCl_2$ in the Beagle dog are being studied to provide a basis for assessing the consequences of inhaling ^{90}Sr such as might be released in certain nuclear accidents. Seventy-two dogs were exposed to aerosols containing ^{90}Sr resulting in initial body burdens ranging from 2.5 to 250 μCi ^{90}Sr/kg body weight. To date, 60 ^{90}Sr-exposed dogs have died or have been euthanized, six during the first 31 days after inhalation of ^{90}Sr with bone marrow aplasia and 54 between 585 and 5109 days after inhalation of ^{90}Sr. The latter group includes 32 dogs with bone-related neoplasms, two with upper respiratory tract carcinomas and five dogs with various diseases of the lower respiratory tract and heart. The other 15 dogs and diseases in organs that received little or no radiation dose, such as the gastrointestinal tract, urinary tract and the central nervous system. The skeletons of the dogs dying with bone-related neoplasms received initial radiation dose rates of 3.2 to 55 rads/day and cumulative doses to death of 2800 to 22 000 rads. Fourteen control dogs have died or been euthanized, two during the last year with mammary carcinoma and intestinal lymphosarcoma. Serial observations are continuing on the six surviving ^{90}Sr dogs and six controls.

35564 (LMF—69, pp 62-65) **Toxicity of inhaled $^{91}YCl_3$ in Beagle dogs. XIII.** Muggenburg, B.A.; Hahn, F.F.; Boecker, B.B.; Jones, R.K.; McClellan, R.O.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The metabolism, dosimetry and effects of inhaled $^{91}YCl_3$ in Beagle dogs are being studied to aid in assessing the biological consequences of nuclear accidents in which ^{91}Y or other radionuclides that produce a similar radiation dose pattern may be released. Forty-two dogs with ^{91}Y initial body burdens from 14 to 1300 μCi/kg body weight were placed in four groups with mean lung burdens of 310, 180, 75 and 40 μCi/kg body weight. These dogs and 12 control dogs are being maintained for lifetime observation. An additional group of four dogs with a mean initial ^{91}Y body burden of 180 μCi/kg body weight were placed in a sacrifice study. Thirty-three of the exposed dogs and four of the control dogs have died. Eleven dogs within the highest activity level groups died or were euthanized at 12 to 33 days after inhalation of ^{91}Y with changes related to severe bone marrow damage and associated pancytopenia. Three dogs died with neoplasms of the upper respiratory tract and three dogs with tumors of the lower respiratory tract from 2012 to 4563 days after exposure. One dog died with a liver related tumor. The remaining 15 dogs died from causes that appear not to be related to the radiation from ^{91}Y. Control dogs died of miscellaneous neoplastic and chronic diseases. Serial observations are continuing on 13 surviving exposed dogs and six surviving unexposed dogs.

35565 (LMF—69, pp 66-70) **Toxicity of inhaled $^{144}CeCl_3$ in Beagle dogs. XIII.** Merickel, B.S.; Hahn, F.F.; Boecker, B.B.; McClellan, R.O.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The metabolism, dosimetry and effects of inhaled $^{144}CeCl_3$ in Beagle dogs are being studied to assess the biological consequences of inhaling ^{144}Ce that might be released in certain nuclear accidents. Studies have shown that the ^{144}Ce deposited in the lung as $^{144}CeCl_3$ is translocated at a moderately rapid rate to liver and skeleton and that significant radiation doses are accumulated by all three organs. Fifty-five dogs that inhaled $^{144}CeCl_3$ and 15 control dogs are being observed for their life span. The ^{144}Ce-exposed dogs had long-term retained burdens that ranged from 2.6 to 360 μCi ^{144}Ce/kg body weight. Fifty of the dogs exposed to $^{144}CeCl_3$ have died; 15 from early effects of radiation exposure, 26 from neoplastic diseases and nine from other diseases. Seven controls have died; three from neoplastic diseases and four from other causes. Serial observations are continuing on the five surviving exposed dogs and eight control dogs.

35566 (LMF—69, pp 71-74) **Toxicity of injected $^{137}CsCl$ in Beagle dogs. XII.** Merickel, B.S.; Hahn, F.F.; Boecker, B.B.; Jones, R.K.; McClellan, R.O.; Pickrell, J.A.; Redman, H.C. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Studies of the metabolism, dosimetry and effects of intravenously administered $^{137}CsCl$ in the Beagle dog are being conducted to aid in assessing the biologic consequences of exposure to ^{137}Cs that might occur in the event of certain nuclear accidents. Effects of the chronic, relatively uniform whole-body exposure produced by ^{137}Cs are being compared with other diverse radiation dose patterns resulting from inhalation of radioactive aerosols. Fifty-four dogs that were injected with $^{137}CsCl$ and 12 control dogs are being observed for their life spans. Twenty-five of the dogs injected with $^{137}CsCl$ have died: 11 of hemotologic dyscrasias, seven of neoplastic diseases and seven from other diseases. Five control dogs have died; one from a neoplastic disease and four from other diseases. Serial observations are continuing on the surviving 29 $^{137}CsCl$ injected dogs and seven control dogs.

35567 (LMF—69, pp 75-78) **Toxicity of ^{90}Y inhaled in a relatively insoluble form by Beagle dogs. XI.** Merickel, B.S.; Hobbs, C.H.; Hahn, F.F.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Studies on the metabolism, dosimetry and biological effects of inhaled ^{90}Y in fused aluminosilicate particles in the Beagle dog are in progress to assess the consequences of inhaling an energetic beta-emitting radionuclide that has a short effective half-life in the lung. A life span study is currently in progress in which 89 dogs were exposed to initial lung burdens ranging from 80 to 5200 μCi/kg body weight and 12 control dogs were exposed to stable yttrium in fused aluminosilicate particles. The doses achieved, short half-life and relative insolubility of the ^{90}Y in this vector resulted in a radiation insult to the lung and surrounding structures at a relatively high, but rapidly decreasing dose rate. To date, 46 exposed dogs have died; 38 from radiation pneumonitis, four from primary pulmonary neoplasms and four from other causes. Forty-three surviving exposed dogs and 12 control dogs are being studied for the remainder of their life span.

35568 (LMF—69, pp 79-82) **Toxicity of ^{91}Y inhaled in a relatively insoluble form by Beagle dogs. X.** Muggenburg, B.A.; Hobbs, C.H.; Hahn, F.F.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The radiation hazards from inhalation of ^{91}Y in fused aluminosilicate particles are being studied in Beagle dogs to assess the biological consequences of inhaling a relatively insoluble, energetic beta emitter with an intermediate effective half-life in the lung. A radiation dose pattern study in which 30 dogs were serially sacrificed from 0 to 320 days after inhalation exposure to ^{91}Y in fused aluminosilicate particles has been completed. A life span study is in progress in which 96 dogs were exposed to achieve initial lung burdens ranging from 11 to 300 μCi ^{91}Y in fused aluminosilicate particles/kg body weight and 12 dogs were exposed to stable yttrium in fused aluminosilicate particles. To date, 60 dogs have died in the longevity study between 113 and 3390 days after exposure. Forty of these dogs, with cumulative radiation doses to lung between 8300 and 60 000 rads, died with clinicopathologic findings of radiation pneumonitis and/or pulmonary fibrosis at 113 to 1011 days after exposure. Fifteen dogs that died between 1115 and 2841 days after

exposure with cumulative doses to lung ranging from 16 000 to 25 000 rads had pulmonary carcinomas. Two dogs have died with hemangiosarcomas with primary sites not in the lung. Deaths are beginning to occur that cannot be easily associated with the radiation exposure. Thirty-six exposed dogs with doses to lung of 2400 to 18 000 rads and 11 control dogs remain alive and will be studied throughout the remainder of their life span.

35569 (LMF—69, pp 92-95) **Toxicity of ^{144}Ce inhaled in a relatively insoluble form by immature Beagle dogs. VIII.** Boecker, B.B.; Merickel, B.S.; Hahn, F.F.; Mauderly, J.L.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The influence of age at exposure on the resulting patterns of deposition, retention, dosimetry and biological effects from a single inhalation exposure to a relatively insoluble form of a beta-emitting radionuclide with a relatively long physical half-life is being investigated. Immature Beagle dogs (3 months of age) have been exposed once, by inhalation, to an aerosol of ^{144}Ce incorporated in fused aluminosilicate particles. Eighteen of these dogs were serially sacrificed to study the patterns of deposition, retention and dosimetry and the remaining 49 dogs received graded initial lung burdens that ranged from 0.004 to 140 μCi ^{144}Ce/kg body weight and are being observed over their life span for study of the resulting long-term biological effects. Five control dogs are also included in this study. To date, 13 of the ^{144}Ce-exposed dogs in the longevity study and none of the controls have died. Dogs with the highest initial lung burdens of ^{144}Ce died first (during the first 4 months) with radiation pneumonitis, pulmonary fibrosis and congestive heart failure. Pulmonary hemangiosarcoma was the primary finding in dogs that died at 1.5 to 2 years after exposure. Deaths beyond that time have primarily involved extrapulmonary hemangiosarcomas. One dog, 627B, with an initial lung burden of 24 μCi ^{144}Ce/kg body weight died during the past year at 2341 days after exposure with a widely disseminated hemangiosarcoma showing heavy involvement of the liver and skin. Observations are continuing on the surviving 36 ^{144}Ce-exposed and five control dogs.

35570 (LMF—69, pp 96-100) **Toxicity of ^{144}Ce inhaled in a relatively insoluble form by aged Beagle dogs. VIII.** Hahn, F.F.; Muggenburg, B.A.; Boecker, B.B.; Mauderly, J.L.; McClellan, R.O.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The toxicity of relatively insoluble ^{144}Ce inhaled by 8- to 10.5-year-old dogs is being investigated to provide information on age-related differences in the response of dogs to lung burdens of this fission product. These data on aged dogs will be compared to the results of similar studies of dogs exposed at approximately 3 months or 12 to 14 months of age. Forty-two dogs were exposed, nose only, to aerosols of ^{144}Ce in fused aluminosilicate particles to yield initial lung burdens of 2.2 to 75 μCi/kg body weight and 12 control dogs were exposed to nonradioactive fused aluminosilicate particles. To date, 37 dogs have died or were euthanized 197 to 2375 days after inhalation of ^{144}Ce. The prominent findings were radiation pneumonitis in 19 dogs that died at early times with cumulative doses to lung of 20 000 to 74 000 rads and neoplastic disease in six of 14 dogs that died 943 days after exposure or later. Pulmonary tumors were found in four of these dogs. However, only one of these tumors killed the dog. No hemangiosarcomas have been observed in this study. This result is in contrast to the results with immature or young adult dogs exposed to ^{144}Ce. The difference may be a dose-related phenomenon since dogs which developed hemangiosarconomas had greater initial lung burdens of ^{144}Ce. Aged dogs with similar burdens died at earlier times with radiation pneumonitis. Observations are continuing on the five surviving ^{144}Ce-exposed and four control dogs.

35571 (LMF—69, pp 117-121) **Toxicity of inhaled alpha-emitting radionuclides - status report.** Muggenburg, B.A.; Mewhinney, J.A.; Hahn, F.F. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

A series of interrelated dose-response studies in which Beagle dogs and rodents are being exposed to aerosols of transuranic alpha-emitting radionculides is described. The characteristics of monodisperse aerosols of oxides of ^{239}Pu, ^{238}Pu, ^{241}Am, ^{244}Cm and ^{242}Cm are discussed for use in studies to determine the relative importance of the resulting biological effects of such factors as the local dose around particles, specific activity, particle size and number of particles inhaled (the hot particle question). Other factors such as the elemental characteristics, the chemical form of the material, species of animal and the age of the animal at the time of inhalation which may influence the toxicity of these radionuclides are also being studied. The purpose of the studies is to determine the basic relationships between the radiation dose pattern and resulting biological effects.

35572 (LMF—69, pp 122-133) **Toxicity of inhaled $^{238}PuO_2$ in Beagle dogs. A. Monodisperse 1.5 μm AD particles. B. Monodisperse 3.0 μm particles. VI.** Mewhinney, J.A.; Merickel, B.S.; Hahn, F.F.; Boecker, B.B.; Diel, J.H.; McClellan, R.O.; Mauderly, J.L.; Muggenburg, B.A.; Pickrell, J.A.; Guilmette, R.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

To obtain essential information on the relative importance of homogeneity of radiation dose to lung from inhaled alpha-emitting radionuclides, Beagle dogs have received an inhalation exposure to one of two sizes of monodisperse aerosols (σ/sub g/ ~ 1.2) of $^{238}PuO_2$ to achieve graded levels of initial lung burden. In each group, 72 Beagle dogs received inhalation exposure to either a 1.5 or 3.0 μm aerodynamic diameter (AD) monodisperse aerosol. For a given level of initial lung burden, the average dose to lung was constant and the local dose differed by a factor of approximately 10. There are six levels of initial lung burden ranging from 0.005 to 2.2 μCi ^{238}PU/kg body weight that resulted in average initial dose rates to lung ranging from 0.12 to 56 rads per day. Twenty-four dogs exposed to the diluent aerosol serve as controls. All animals are being studied over their life span. Forty-two dogs have died from radiation-related injury with initial lung burdens ranging from 0.18 to 2.2 μCi ^{238}Pu/kg body weight. Of the 42 radiation injury deaths, 7 animals died with radiation pneumonitis and pulmonary fibrosis, 9 died with lung tumors and 33 animals died with bone tumors. Assessment of the distribution of ^{238}Pu in organs and tissues and histopathological examination is complete for 37 animals that have died. Two control animals have died in the study. One hundred exposed and 22 control animals are surviving at 1290 to 2118 days after inhalation exposure.

35573 (LMF—69, pp 134-140) **Toxicity of inhaled $^{239}PuO_2$ in Beagle dogs. A. Monodisperse 0.75 μm AD particles. B. Monodisperse 1.5 μm AD particles. C. Monodisperse 3.0 μm AD particles. III.** Muggenburg, B.A.; Guilmette, R.A.; Hahn, F.F.; Boecker, B.B.; McClellan, R.O.; Mauderly, J.L.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Studies on the metabolism, dosimetry and biological effects of inhaled particles of $^{239}PuO_2$ in Beagle dogs are in progress. To obtain information on the relative importance of homogeneity versus nonhomogeneity of radiation doses to the lung, dogs have been exposed to monodisperse aerosols of $^{239}PuO_2$ of 0.75, 1.5 or 3.0 μm aerodynamic diameter (AD). By using monodisperse aerosols of three different suitable particle sizes, the average dose to lung can be held constant for a given initial lung burden while the local dose around the different sized particles can differ by a factor of $\simeq$ 140. The exposures have resulted in graded initial lung burdens ranging from 0.0002 to 2.6 μCi/kg body weight. Other dogs were exposed to the aerosol diluent to serve as controls. Fifteen dogs have died at 152 to 728 days after exposure in the 1.5 μm AD study and 16 dogs have died at 105 to 876 days after exposure in the 3.0 μm AD study. These dogs had radiation pneumonitis and pulmonary fibrosis at death. All of the dogs exposed to 0.75 μm AD $^{239}PuO_2$ are alive. Levels of exposure to 0.75 μm AD were all lower than those which caused early deaths from exposures to the other aerosols. The remaining dogs have survived up to 999 days after exposure and are being observed for the remainder of their life span.

35574 (LMF—69, pp 141-144) **Toxicity of inhaled $^{239}PuO_2$ in aged Beagle dogs.** Stanley, J.A.; Muggenburg, B.A.; Hahn, F.F.; Guilmette, R.A.; Merickel, B.S.; Boecker, B.B.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Studies to determine the effects of age at exposure on the metabolism, dosimetry and biological effects of inhaled particles of $^{239}PuO_2$ have been initiated in aged Beagle dogs (8.0 to 10.5 years of age at exposure). To date, 20 Beagle dogs have been exposed to 1.5 μm AD particles of $^{239}PuO_2$ resulting in initial lung burdens ranging from 0.03 to 0.76 μCi/kg body weight. Five dogs exposed to the aerosol diluent serve as controls. One dog died 129 days after exposure with radiation pneumonitis. The remaining dogs are still alive at 128 to 173 days after exposure. It is anticipated that the remaining dogs planned for this study will be exposed over the next 24 to 36 months.

35575 (LMF—69, pp 145-149) **Toxicity of inhaled $^{239}PuO_2$ in immature Beagle dogs.** Stanley, J.A.; Merickel, B.S.; Guilmette, R.A.; Hahn, F.F.; Mauderly, J.L.; Muggenburg, B.A.; Boecker, B.B.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Immature Beagle dogs (approximately 3 months of age at exposure) have been exposed by inhalation to 1.5 μm aerodynamic diameter particles of $^{239}PuO_2$ to compare the resulting patterns of metabolism, dosimetry and biological effects with those seen in young adult (12 to 14 months of age) and aged (8 to 10.5 years of age) dogs exposed to the same aerosol. To date, 18 dogs have been

exposed to the aerosol, resulting in graded initial lung burdens ranging from 0.002 to 0.31 μCi/kg body weight. Two dogs have been exposed to the aerosol diluent and serve as controls. Two of the 18 exposed animals were sacrificed 8 days after exposure to provide information on initial deposition and distribution. The remaining animals are alive at 33 to 54 days after exposure. It is anticipated that the other dogs planned for this study will be exposed over the next 18 months. All of the dogs in this study are being exposed under general anesthesia with the use of an endotracheal tube to provide constant conditions. The initial deposition and distribution of the aerosol in the dogs sacrificed at 8 days was similar to that observed in young adult dogs given nose-only exposures to the same type of aerosol.

35576 (LMF—69, pp 150-153) **Toxicity of inhaled $^{239}PuO_2$ in Fischer 344 rats.** Redman, H.C.; Boecker, B.B.; Muggenburg, B.A.; Griffith, W.C.; Guilmette, R.A.; Mewhinney, J.A.; Scott, B.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Studies on the biological effects of inhaled particles of $^{239}PuO_2$ have been initiated in the Fischer 344 rat. To obtain information on the importance of homogeneity or nonhomogeneity of radiation dose to the lung, young adult (84 +- 7 days) animals have been exposed to monodisperse aerosols (σ/sub g/ < 1.2) of $^{239}PuO_2$ of 1.0 and 2.8 μm aerodynamic diameter (AD). To determine the effects of age at exposure, aged rats (600 to 660 days) have been exposed to monodisperse aerosols of $^{239}PuO_2$ of 1.0 μm aerodynamic diameter. To date, 480 young adult rats have been exposed to $^{239}PuO_2$: 240 rats to 1.0 μm AD particles and 240 rats to 2.85 μm AD particles. The projected exposure level ranged from 0.012 to 0.115 μCi/kg body weight. One hundred sixty rats were sham-exposed and maintained as controls. Also, 240 aged rats have been exposed to date to 1.0 μm AD particles of $^{239}PuO_2$. The projected activity level ranged from 0.012 to 0.115 μCi/kg body weight. Eighty rats were sham-exposed and maintained as controls. In addition, a serial sacrifice study to determine radiation-dose pattern in rats resulting from the inhalation of these monodisperse aerosols of $^{239}PuO_2$ has been initiated in the young adult rat.

35577 (LMF—69, pp 154-161) **Effect of $^{239}PuO_2$ particles or ^{239}Pu citrate on the production of liver cancer in the Chinese hamster.** Brooks, A.L.; Benjamin, S.A.; Brownstein, D.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Graded levels of ^{239}Pu citrate or $^{239}PuO_2$ particles of known size were injected into the jugular sinus of Chinese hamsters to produce a range of local dose distributions in the livers. The plutonium citrate was deposited uniformly throughout the liver with about 60% of the activity located in the liver and 40% in bone. Plutonium oxide particles were taken up by the reticuloendothelial system with 90% of the body burden being deposited in the liver. The particles produced a non-uniform distribution of radiation dose in the liver which was dependent on the particle size. Plutonium citrate resulted in greater life shortening per μCi injected than $^{239}PuO_2$ particles. The plutonium citrate also produced tumors in bone and bone marrow and liver hemangiosarcomas that were not observed after exposure to $^{239}PuO_2$ particles. The time between injection and the observation of liver tumors was shorter in hamsters exposed to ^{239}Pu citrate than in those exposed to the $^{239}PuO_2$ particles. The average time liver tumor occurrence became longer and the tumor frequency decreased as a function of decreasing injected activity and liver dose for animals injected with either ^{239}Pu citrate or $^{239}PuO_2$ particles. The total liver tumor incidence was similar for animals exposed to either the ^{239}Pu citrate or $^{239}PuO_2$. Collectively, these data indicate that changes in local dose distribution had little effect on the incidence of liver cancers in Chinese hamsters.

35578 (LMF—69, pp 179-181) **Repeated inhalation exposure of Beagle dogs to aerosols of $^{239}PuO_2$. III.** Diel, J.H.; Lundgren, D.L.; Merickel, B.S.; Mewhinney, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

In this experiment, we are studying the biological behavior and long-term biological effects of repeated inhalation exposure of Beagle dogs to $^{239}PuO_2$ particles compared with those seen in dogs that received a single exposure as young adults. Dogs are being exposed by inhalation to a monodisperse aerosol of 0.75 μm AD $^{239}PuO_2$ particles at either α 0.1 μCi or 0.01 μCi lung burden of ^{239}Pu at half-year intervals for 10 years or only once to 0.1 μCi of ^{239}Pu using the same aerosols. A sacrifice series exposed repeatedly to a 0.1 μCi lung burden of ^{239}Pu has been included to determine the distribution of PuO_2 resulting from this type of exposure schedule. All dogs in this study have been exposed at least four times. Analysis of tissues from sacrificed animals indicates that the $^{239}PuO_2$ is retained primarily in the lung up to 1 year after initial exposure. No adverse biological effects of these exposures have been observed up to 2 years after initial exposure.

35579 (LMF—69, pp 195-198) **Removal of inhaled mixed oxide particles of uranium and plutonium from Beagle dogs using combined lung lavage and DTPA treatment.** Muggenburg, B.A.; Eidson, A.F.; Mewhinney, J.A.; Guilmette, R.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This study was conducted to evaluate lung lavage and diethylenetriaminepentaacetic acid (DTPA) for the removal of inhaled, industrially produced mixed oxides of plutonium and uranium. The study was conducted in adult Beagle dogs exposed by inhalation to aerosols of plutonium and uranium mixed oxides. The dusts from which the aerosols were generated were collected in glove boxes from fuel processing plants. One group of five dogs was exposed to an aerosol of a mixture of PuO_2 and UO_2. The second group of five dogs was exposed to an aerosol of a solid solution of plutonium and uranium oxides. The third group of five dogs was exposed to nearly pure $^{239}PuO_2$. Three dogs in each group were treated with ten lung lavages and 18 intravenous injections of DTPA. All dogs were sacrificed at 64 days after exposure. The plutonium was retained in the lung of the untreated dogs with little translocation. Lung lavage treatment resulted in the removal of 57, 56 and 66% of the initial lung burden of plutonium from dogs in the three groups, respectively. The DTPA injections did not increase the excretion of plutonium in the urine. The removal of plutonium by lung lavage resulted in a greatly decreased lung burden of plutonium. There was no difference in the effect of treatment among the three groups of dogs.

35580 (LMF—69, pp 259-262) **Pulmonary deposition of a /sup 99m/Tc-labeled aerosol in a whole-body exposure.** Griffis, L.C.; Wolff, R.K.; Beethe, R.L.; Hobbs, C.H.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Pulmonary deposition of a /sup 99m/Tc-labeled aerosol was studied in 144 Fischer 344 rats using a recently designed multi-tiered exposure cchamber. An equal number of males and females (12) were housed on each of six shelves in the chamber and exposed for approximately 130 minutes to a CsCl aerosol labeled with /sup 99m/Tc. The activity median aerodynamic diameter and geometric standard deviation of the aerosol were estimated to be 2.1 μm and 1.7, respectively. The aerosol concentrations within the chamber had a coefficient of variation of 9%. The total lung burden in male and female rats was 1.9 and 1.4 units of aerosol, respectively, per hour of exposure at an aerosol concentation of 1 unit per liter. Two-way analysis of variance indicated male rats deposited significantly more aerosol (15%) per gram of wet lung tissue, while females deposited 21% more per gram of body weight. Lung deposition of rats housed on one side of the chamber was also found to be significantly higher than the lung deposition of rats housed on the other side. This difference corresponded to a slight difference in aerosol concentration observed between the two sides of the chamber.

35581 **Distribution and retention of hexavalent ^{233}U in the beagle.** Stevens, W.; Bruenger, F.W.; Atherton, D.R.; Smith, J.M.; Taylor, G.N. (Univ. of Utah, Salt Lake City). Contract EY-76-C-02-0119. *Radiat. Res.;* **83**: No. 1, 109-126(Jul 1980).

The distribution, retention, and excretion of ^{233}U were measured in seven beagles injected intravenously with 2.8 μCi ^{233}U(VI)/kg (~ 3 mg/dog) in citrate buffer and sacrificed at times ranging from 1 to 726 days postinjection (PI). The concentration of U in plasma decreased rapidly, and for the first 24 h PI could be described by triphasic exponential equation with half-times of 0.92, 46, and 315 min. The uranium in the blood at 5 min PI was present as either a protein (transferrin-albumin) or a carbonate/bicarbonate complex. Up to 60% of the injected U was excreted during the first day, most of it in the urine. Whole-body retention was 17% at 7 days, 10% at 94 days, 7.6% at 1 year, and less than 5% at 2 years PI. Except for the kidney, only a small fraction of the injected U was retained in soft tissues. At 1 day PI, the liver contained 1.1% of the injected U and its subcellular distribution was similar to that seen with Pu(IV). At 1 day PI, 7.7% of the U was found in the skeleton; this amount decreased with a biological half-life of 883 days. Initially, U was deposited nonuniformly on bone surfaces with areas of intense hot spots adjacent to areas with intermediate and low concentrations. At later times redistribution and/or diffusion of U into the bone volume produced a deposition pattern intermediate to that of ^{239}Pu (surface) and ^{226}Ra (volume). The heterogeneit of surface deposits persisted, and isolated segments of the trabecular bone showed intense surface deposits at times greater than 1 year PI. Twnety-two percent of the injected U was found in the kidneys at 1 day PI with high concentrations localized in the proximal tubules. The initially high concentration of U in this organ was correlated with extensive diuresis and a persistent elevation in blood urea nitrogen. Damage to proximal tubules was attributed primarily to chemical toxicity but was aggravated by simultaneous α irradiation.

35582 **Cytogenetic and other biological effects of $^{239}PuO_2$ inhaled by the rhesus monkey.** LaBauve, R.J.; Brooks, A.L.; Mauderly, J.L.; Hahn, F.F.; Redman, H.C.; Macken, C.; Slauson, D.O.; Mewhinney, J.A.; McClellan, R.O. (Lovelace Biomedical and Environmental

Research Inst., Albuquerque, NM). *Radiat. Res.;* **82**: No. 2, 310-335(May 1980).

Sixteen immature rhesus monkeys were exposed via inhalation to an insoluble, polydisperse $^{239}PuO_2$ aerosol labeled with ^{169}Yb which had an activity median aerodynamic diameter of 1.6 μm and a σ/sub g/ of 1.6. Four groups with three monkeys per group were exposed to achieve initial ^{239}Pu lung burdens of 1000 to 2000, 200 to 300, 20 to 65, and 2 to 10 nCi, respectively. To determine early retention and distribution of the aerosol, four additional monkeys were exposed with initial lung burdens of 200 to 600 nCi and were sacrificed 4 hr and 30 days after inhalation exposure. Two monkeys were sham exposed and served as controls. Using data derived from external whole-body counting of the ^{169}Yb label, it was estimated that the inhaled $^{239}PuO_2$ was retained in the body with an average effective half-life of 1000 days with some translocation from the lung to the pulmonary lymph nodes. Chromosome aberrations were scored in blood lymphocytes cultured 1, 3, 7, 19, 31, and 43 months after inhalation. Only in animals with cumulative lung doses greater than 1000 rad was there a significant increase in the frequency of rings and dicentrics when compared to the controls. An animal with an estimated initial lung burden of 1000 nCi showed marked alterations in respiratory function 30 days prior to his death from pulmonary fibrosis 990 days after inhalation exposure. Only slight respiratory changes were detected in the other animals evaluated. To date, three monkeys have died, two with initial lung burdens of 1800 and 1000 nCi ^{239}Pu which died from radiation pneumonitis and the third with an initial lung burden of 20 nCi which died of gastric torsion presumably not related to Pu exposure. Comparison of survival data from rhesus monkeys with those obtained from baboons and beagles indicates that rhesus monkeys, baboons, and dogs are similar in their early response to inhaled $^{239}PuO_2$.

35583 **Repeated inhalation exposure of mice to $^{144}CeO_2$.** Lundgren, D.L.; McClellan, R.O.; Hahn, F.F.; Newton, G.J.; Diel, J.H. (Inhalation Toxicology Research Inst., Albuquerque, NM). Contract EY-76-C-04-1013. *Radiat. Res.;* **82**: No. 1, 106-122(Apr 1980).

The potential exists for humans to be repeatedly or chronically exposed by inhalation to radionuclides in relatively insoluble forms; however, only limited experimental data are available on the effects of such exposures. Female mice were repeatedly exposed by inhalation at approximately 60-day intervals for 1 year to $^{144}CeO_2$ to reestablish lung burdens of either 0.2, 1.0, or 4.5 μCi of ^{144}Ce to determine the effect of repeated exposure on ^{144}Ce retention and dosimetry. The long-term effective retention half-times of ^{144}Ce in the lung, liver, and skeleton after the last repeated inhalation exposure were similar to those in mice exposed once by inhalation to $^{144}CeO_2$. A mathematical simulation model was developed as an alternative method of describing the pulmonary clearance of ^{144}Ce after repeated exposures by inhalation to aerosols of $^{144}CeO_2$. The cumulative radiation doses to the lungs, livers, and skeletons of the repeatedly exposed mice were similar to those which would have occurred had the total lung burden been achieved by a single exposure. The repeatedly exposed mice also had temporal radiation dose patterns to the lung similar to beagle dogs exposed once.

PLANTS

REFER ALSO TO CITATION(S) 35452

THERMAL EFFECTS

CELLS

REFER ALSO TO CITATION(S) 35524

INVERTEBRATES

35584 (PB—80-119829) **Results of benthic studies at Calvert Cliffs. Final report.** Holland, A.F.; Mountford, N.K.; Heigel, M.; Cargo, D.; Mihursky, J.A. (Maryland Univ., Solomons (USA). Chesapeake Biological Lab.). Nov 1979. 258p. NTIS, PC A12/MF A01.

The report summarizes data from seven years of benthic studies conducted at the Calvert Cliffs Nuclear Power Plant for the siting program in Maryland. The impacts of entrainment and thermal pollution on benthic communities as a result of the operation of the plant are described in the report.

VERTEBRATES

REFER ALSO TO CITATION(S) 35584

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 35595

35585 (LMF—69, pp 203-206) **Identification of organic compounds in diesel exhaust particles.** Hanson, R.L.; Royer, R.E.; Brooks, A.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Fractions of dichloromethane extracts of diesel exhaust particles were analyzed by gas chromatography/mass spectrometry (GC/MS). Tentative identification of components indicated that several mutagens were present in some of these fractions. The aliphatic hydrocarbons were isolated in the first two fractions, which possessed no mutagenic activity, while the polynuclear aromatic hydrocarbons were found in the remaining four fractions, which did have mutagenic activity.

35586 (LMF—69, pp 219-223) **Generation and characterization of surrogate diesel aerosols.** Kanapilly, G.M.; Wolff, R.K. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

One approach to the evaluation of the deposition characteristics and other dose-modifying factors of inhaled diesel exhaust aerosols is the development of radioactive surrogate aerosols for use in inhalation studies. In this report the generation and characterization of branched-chain aggregate aerosols of Ga_2O_3 and Co_3O_4 which are suitable for inhalation studies are described. Experimental conditions for producing these aerosols with physical and deposition characteristics similar to the diesel exhaust aerosols and with sizes (of the aggregates) ranging from 10 to 100 μm are discussed.

35587 (LMF—69, pp 263-265) **Aerosol distribution in a multi-tiered chamber.** Beethe, R.L.; Hobbs, C.H.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Chronic inhalation exposures, planned as part of a diesel health effects study, require inhalation exposure of many experimental animals utilizing minimal floor space and minimal animal handling personnel and time. An aerosol distribution study was performed on a newly designed multi-tiered exposure chamber which was provided through cooperative agreement with Hazelton Systems, Inc., and Battelle Pacific Northwest Laboratory. The coefficient of variation of the concentration of aerosol at 18 different locations within the chamber never exceeded 8% indicating that the chamber performed well and was suitable for use in chronic inhalation exposures.

35588 (LMF—69, pp 555-560) **Application of the scanning electron microscope to the study of the effects of fibrous glass and asbestos on lung tissue.** DeNee, P.B.; DeNicola, D.B.; Rebar, A.H.; Pickrell, J.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This paper demonstrates how the scanning electron microscope (SEM) has been used to study the effects of fibrous material (such as fibrous glass and asbestos) on the lung. The SEM was used to size the fibers before and during aerosolization and after deposition in animal lungs. The SEM and the light microscope were used to correlate the presence of fibers and lung pathology.

35589 (ORNL/EIS—85) **Reviews of the environmental effects of pollutants. IX. Fluoride.** Drury, J.S.; Ensminger, J.T.; Hammons, A.S.; Holleman, J.W.; Lewis, E.B.; Preston, E.L.; Shriner, C.R.; Towill, L.E. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 458p. (EPA—600/1-78-050). NTIS, PC A20/MF A01.

This study is a comprehensive, multidisciplinary review of the health and environmental effects of fluoride on microorganisms, plants, wild and domestic animals, and humans. More than 1000 references are cited. Human intake of fluoride is chiefly through the diet; drinking water is normally the largest single source. Low concentrations of fluoride in water (approximately 1 ppM) benefit mammalian systems, making bone and tooth apatite less soluble, but long-term ingestion of water containing more than 8 ppM fluoride causes fluorosis in humans. Fluoride salts are lethal to humans when ingested in doses of about 3 g or more. At concentrations normally encountered by the general public, fluoride is not teratogenic, mutagenic, or carcinogenic to humans, but chronic fluoride toxicosis of both livestock and wildlife is an important problem in many areas of the United States. The principal manifestations of chronic fluoride toxicosis in livestock are dental fluorosis, osteofluorosis, lameness, and impaired performance. Among domestic animals, dairy cattle are the most sensitive to excessive fluoride exposure.

CELLS

REFER ALSO TO CITATION(S) 35393, 35481

35590 (CONF-8006117—1) **Control of mammalian cell mutagenesis and differentiation by chemicals which initiate or promote tumor formation.** Jones, C.A.; Huberman, E. (Tennessee Univ., Oak Ridge (USA). Graduate School of Biomedical Sciences; Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

From Workshop on biological carcinogenesis; Detroit, MI, USA (11 Jun 1980).

A cell-mediated mutagenesis assay was developed to predict the potential carcinogenic hazard of some environmental chemicals. In this assay, Chinese hamster V79 cells, which are susceptible to mutagenesis, are co-cultivated with cells capable of metabolizing chemical carcinogens. Use of this assay made it possible to demonstrate a relationship between the degree of carcinogenicity and mutagenicity of a series of polycyclic hydrocarbons and nitrosamines and to study the organ specificity exhibited by some chemical carcinogens. However, most short-term in vitro assays are designed to detect mutagenic activity and therefore do not detect tumor promoting agents which are devoid of this activity. By analyzing various markers of terminal differentiation in cultured human melanoma and myeloid leukemia cells, we have established a relationship between the activity of a series of tumor promoting phorbol diesters in the mouse skin and their ability to induce terminal differentiation. We suggest that measuring alterations in the differentiation characteristics of some cultured cells may represent an approach by which environmental tumor promoting agents can be studied and detected.

35591 (LMF—69, pp 233-238) **Mutagenic characterization of particulate materials in diesel exhaust.** Brooks, A.L.; Clark, C.R.; Royer, R.E. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Bacterial mutagenesis (Ames) tests were used to characterize the mutagenic activity of materials extracted from particles in exhaust from diesel engines. Using bacterial strain TA-98, we have tested crude extracts from five different engine types and found a range of revertants from 0.16 revertants/μg to 4 revertants/μg of crude extract. There was a range of up to four fold in the mutagenic activity/μg of diesel particle equivalent between filter samples collected from the same car. Filters were extracted with either dichloromethane or propanol:toluene (1:1) using either ultrasonic or Soxhlet extraction techniques. The total activity was similar in samples extracted with either solvent or by either extraction technique. Aqueous/organic partitioning did not separate the mutagenic activity from the bulk of the extracted material. Column chromatography of the crude extracts on Sephadex LH-20 separated the bulk of the material with no mutagenic activity (about 70%) and concentrated the mutagenically active fractions into less than 25% of the total mass. Future research will include further fractionation and characterization of the chemical responsible for the mutagenic activity of diesel particle extracts.

35592 (LMF—69, pp 239-243) **Biological availability of mutagenic chemicals associated with diesel exhaust particles.** Brooks, A.L.; Royer, R.E.; Sanchez, A.; Clark, C.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Research has been conducted on the ability of biologically relevant solvents to extract mutagenic activity from diesel exhaust particles to aid in estimating the cellular dose of the mutagens following inhalation exposure to diesel exhaust. The mutagenic activity of dichlormethane, dog serum, lung lavage fluid, saline, dipalmitoyl lecithin and albumin following incubation of the fluids with diesel exhaust particles was determined in the Ames Salmonella system. Large quantities of mutagenic activity were removed by the organic solvent, dichloromethane. A very small amount of mutagenic activity was removed by the serum and lavage fluid over a 3-day incubation period. No activity was detected with the other solvents. The minimal mutagenic activity demonstrated in the biological media following incubation with diesel exhaust particles may be due to a lack of removal of mutagens from the particles or an inactivation of removed mutagens by binding or some other process.

35593 (LMF—69, pp 244-247) **Influence of lung and liver enzymes on the mutagenicity of diesel soot extracts.** Clark, C.R.; Vigil, C. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Extracts of diesel soot were evaluated in the Salmonella mutagenicity assay with and without the addition of liver and lung enzyme preparations. Strain TA-100 was ten-fold more sensitive than strain TA-1538 in detecting direct acting mutagens in the extracts. Enzyme preparations from Aroclor 1254-induced rat livers and from BaP-induced and uninduced rat lungs significantly decreased the mutagenicity of the extracts in TA-100 and slightly increased the mutagenicity in TA-1538. Levels of arylhydrocarbon hydroxylase activity in the tissues do not appear to be related to their ability to activate promutagens or detoxify direct acting mutagens in the diesel particle extract. The comparability of the TA-100 response with lung and liver enzymes suggests that the lung may be an important site of detoxification of organics associated with diesel soot.

35594 (LMF—69, pp 248-251) **Use of sister chromatid exchanges to monitor for genetic changes induced by complex environmental samples.** Brooks, A.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Sister chromatid exchanges (SCE's) in CHO cells in vitro are being used to evaluate mutagenic response to environmental pollutants. Positive controls using benzo(a)pyrene and ethyl methylsulfonate were used to evaluate the response of the system with and without metabolic activation provided by liver S-9 microsomal fraction. Positive dose response relationships were established for the ether soluble basic fractions of a subfraction from coal gasifier tar and for crude extracts of diesel particles. The addition of S-9 decreased the frequency of SCE's for the coal tar extract at the lower concentrations and increased it at higher concentrations. The magneitude of the response of SCE's to both of these complex mixtures was marginal at the levels tested. Additional research using fractionated samples is required to determine if SCE frequency can be a useful system to detect mutagenic activity in complex environmental pollutants.

35595 (LMF—69, pp 252-256) **Cytotoxicity of diesel soot on mammalian cells in culture.** Li, A.P.; Royer, R.E. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The cytotoxicity of a methylene chloride extract of diesel soot (crude extract) and that of fractions of the crude extract after Sephadex chromatographic separation were tested using Chinese hamster ovary cells. The majority of the cytotoxic components were found in the aliphatic hydrocarbons (Fraction 2) and alkyl-substituted aromatics and heterocyclics (Fraction 3) fractions. Our results suggest that the major cytotoxic components of the diesel extract are different from the mutagenic components (as demonstrated by Ames test), which were found mostly in the polycyclic hydrocarbon, heterocyclic and quinone fraction (Fraction 4).

35596 (LMF—69, pp 377-383) **Mutagenicity of extracts from fly ash produced by a fluidized bed combustor burning oil shale.** Brooks, A.L.; Sanchez, A.; Hanson, R.L.; Carpenter, R.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The mutagenic activity of extracts of fly ash produced by the burning of oil shale in a fluidized bed combustor (FBC) was determined in a bacterial mutagenesis assay (Ames test). Extracts of the oil shale ash contained several oxygenated hydrocarbons that have not been detected in coal-derived ash. The mutagenic activity of the extract from oil shale ash was higher when the extracts were made with more polar solvents, such as DMSO, than with the less polar solvent, CH_2Cl_2. In the case of FBC bag ash from coal combustion, CH_2Cl_2 extracts were found to have greater mutagenic activity than DMSO extracts. The DMSO extract of oil shale ash was partitioned into a pentane and a DMSO-water phase. The mutagenic activity was in the nonpolar pentane phase. Utilization of more biologically relevant solvents indicated that some mutagenic activity was extracted by sonication with horse serum but the incubation of ash derived from oil-shale with horse serum or dog lavage material did not extract significant amounts of mutagenic material. The limited solubility in biological solvents may indicate a limited availability of the organics for production of mutations in vivo.

35597 (LMF—69, pp 384-390) **Influence of operating conditions and particle size on mutagenicity of FBC fly ash.** Clark, C.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Salmonella (Ames) mutagenicity bioassays have been used to detect potential mutagens in the process stream, at different locations in the cleanup system, and to evaluate changes in mutagenicity associated with the use of different fuel types and operating conditions in an experimental fluidized bed combustor (FBC). Dose-dependent mutagenicity in at least three tester strains was detected in six of the nine bag filter fly ash extracts; the addition of a metabolic activating system (rat liver S-9) either increased, decreased or did not change the direct mutagenicity observed, depending upon the tester strain and extract used. Mutagenicity of respirable fly ash ($<$ 10 μm) increased as the particle size decreased. No mutagenicity was detected in vapor-phase hydrocarbons collected from four different positions in the process stream. Mutagenicity was detected in five of seven bag filter ash samples obtained from the combustion of Montana Rosebud subbituminous coal. Combustion temperature and particle size may be critical variables in the mutagenicity of FBC fly ash.

35598 (LMF—69, pp 391-396) **Mutagenicity of quinolines and their effect on rat lung and liver aryl hydrocarbon hydroxylase activity.** Benson, J.; Kubrick, R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Quinolines are potentially toxic components of tar effluents produced during the low Btu gasification of coal. In initial studies on the biochemical and toxicological effects of this group of compounds, several quinoline derivatives were assayed for their mutagenicity toward Salmonella typhimurium and for their ability to affect rat lung and liver aryl hydrocarbon hydroxylase (AHH) activity following administration to animals by intratracheal instillation or intraperitoneal injection. No compound was directly mutagenic, nor was activated to mutagenic compounds by homogenized rat lung supernatant. Quinoline, 6-methylquinoline and phenanthridine were mutagenic when incubated with homogenized rat liver supernatant. Comparison of the mutagenicity of aza-arene-containing fractions of low Btu gasifier tar with that of certain quinolines, indicate that quinolines may be responsible for the mutagenicity of aza-arene-containing fractions of gasifier tar. No compound significantly affected lung or liver AHH activity when administered intratracheally. All compounds except quinoline and 6-methylquinoline significantly increased ($p = 0.05$) liver AHH activity following their administration to rats by intraperitoneal injection.

35599 (LMF—69, pp 397-400) **In vitro metabolism of phenanthridine.** Benson, J.M. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Metabolism of phenanthridine by rat lung and liver microsomes has been investigated. Microsomes from rat liver and, to a lesser extent, rat lung, metabolized phenanthridine. Both quantitative and qualitative differences were seen in the array of metabolites formed by liver and lung microsomes. Structure and toxicological significance of the metabolites is currently being investigated.

35600 (LMF—69, pp 401-402) **Cytotoxicity of low Btu gasifier effluents.** Hill, J.O.; Royer, R.E.; Mitchell, C.E. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

In vitro cytoxicity testing of fractions of disengagement tars from a low Btu gasifier showed Fraction 5 (aromatics with polar groups and aza-arenes) to be most toxic. Within Fraction 5 the toxicity was distributed over various subfractions with ether soluble acids showing slightly more toxicity in vitro than the other subfractions.

35601 (LMF—69, pp 403-405) **Cytotoxicity of selenium compounds released during fossil fuel combustion.** Burkstaller, M.A.; Cuddihy, R.G.; Hill, J.O.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Selenium compounds released during fossil fuel combustion may pose a potential inhalation hazard to people. Most probable forms of selenium released during combustion are selenious acid Se(IV) and elemental selenium Se(O). The in vitro cytotoxicity of these compounds to rabbit alveolar macrophages was investigated and compared to compounds of vanadium and cadmium. Macrophages were obtained by lung lavage and exposed in tissue culture for 20 hours. Neither selenious acid nor elemental selenium caused cell lysis at concentrations which decreased total cell viability. Selenious acid was an order of magnitude more toxic than elemental selenium. Elemental selenium was similar in toxicity to environmental contaminants such as Cd(II) and V_2O_5.

35602 (LMF—69, pp 406-409) **In vitro and in vivo toxicity of potential organometallic compounds associated with coal conversion processes.** Hill, J.O.; Giere, M.S.; Pickrell, J.A.; Hahn, F.F.; Dahl, A.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Organometallic compounds potentially associated with effluents from coal conversion processes were screened in vitro for cytotoxicity. Two compounds, diphenyl selenium and dibutylgermanium dichloride were tested in vivo along with the known toxic organometallic, dibutyltin dichloride. The three compounds that were toxic to lymphocytes in vitro were also toxic in vivo with lymphoid tissues affected, particularly in the animals exposed to the tin compound. Future tests will determine if the in vitro screening will continue to prove reliable in predicting the toxicity of organometallic compounds in vivo.

35603 (LMF—69, pp 410-412) **Immune complement activation by fly ash particles from coal combustion.** Hill, J.O.; Hanson, R.L.; Scott, B.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

In vitro activation of immune complement was further explored as a rapid screening assay for biological activity and toxicity. Of fly ash samples from different coal combustors burning different feed stocks, only one sample type was active. The activity was associated with a saline-soluble surface component(s). The presence of complement cleavage products, indicative of complement activation, was confirmed by immunelectrophopesis and immunofluorescence.

35604 (LMF—69, pp 502-505) **Determination of DNA damage and repair in vivo and in vitro following exposure to carcinogenic compounds.** Harpaz, R.; Mitchell, C.E. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

An alkaline sucrose gradient centrifugation technique was applied to detect DNA damage and repair both in vivo and in vitro following exposure to various compounds. The monitoring of such DNA modifications ban be employed as a rapid bioassay to help determine the carcinogenic potential of the many materials released during fossil fuel utilization. Chinese hamster ovary (CHO) cells were labeled with ^{3}H-thymidine and then exposed for 1 hour to the alkylating agent, ethyl methane sulfonate. These cells were harvested either 1 or 24 hours after the treatment. The CHO cells were applied to alkaline sucrose gradients for sedimentation analysis. Damage of the cellular DNA followed by its repair was reflected in a reduction of DNA size at 1 hour after exposure followed by its return to control size by 24 hours. The DNA of neonatal rats was labeled with ^{3}H-thymidine. The rats were subcutaneously exposed to 50 mg/kg of the lung-specific carcinogen, 4-nitroquinolin-1-oxide, and sacrificed 4 or 48 hours after treatment. A nuclear suspension was obtained after squashing the lung tissue with a spatula through cheesecloth supported on a Buchner funnel. The resulting nuclear suspension was analyzed for its DNA sedimentation pattern. A reduction in DNA size was observed after 4 hours with a subsequent return to the control sedimentation pattern by 48 hours after exposure.

35605 (LMF—69, pp 533-538) **Alteration of mean lung cell-cycle time following inhalation injury.** Hackett, N.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Quantitative evaluation of mean cell-cycle time alterations in alveolar Type II cells, determined from autoradiographs, provides a base for estimation of the lung repair capacity following inhalation injury. The methods utilizing statistical distribution of the silver grains, disappearance of heavily-labeled cells and calculation from labeling index were used to analyze cytokinetic data of the labeling pattern and to determine the mean cell-cycle time of Type II cells after injury. Chinese hamster Type II cell mean cell-cycle time is reduced from 26 to 3 days following a 24-hour exposure to 28 mg/m^3 NO_2. Rat Type II cell mean cell-cycle time is reduced from 50 to 8 days following exposure to 10 mg/m^3 NO_2. Analysis of the statistical distribution of grain counts permits calculation of the cell fraction which has undergone division during the observation period.

MICROORGANISMS

REFER ALSO TO CITATION(S) 35515, 35638

35606 (CONF-800680—4) **Short-term microbial testing of shale oil materials.** Rao, T.K.; Epler, J.L.; Guerin, M.R.; Clark, B.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01.

From Symposium on health effects investigations of oil shale development; Gatlinburg, TN, USA (23 Jun 1980).

Paraho/Sohio Shale Oil was found to be mutagenic in the Ames assay when assayed with the frameshift strain TA98 and incorporating metabolic activation with rat liver homogenates (Aroclor induced S-9). The mutagenic activity was contributed by the organic constituents of the basic and the neutral fractions. Hydrotreatment of the shale oil abolished the mutagenic activity. Results obtained in the yeast assay supported these observations. Refined oil samples from Paraho/Sohio refinery were not mutagenic. The samples rank for their mutagenic activity as coal oils > shale oil > natural petroleum crudes.

35607 (LMF—69, pp 211-216) **Influence of sampling filter media on the mutagenicity of diesel soot.** Clark, C.R.; Salmeen, I.T. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Studies are being conducted to determine if mutagenicity associated with organics on diesel soot particles may arise in part from filter artifacts. The particulate exhaust from a 2.3 l diesel automobile was collected in a dilution tunnel on teflon membrane (Ghia) filters, teflon-coated glass fiber filters (T60A20 Pallflex) and quartz fiber filters. The filters were then extracted with methylene chloride. Bioassay of the extracts in the Salmonella mutagenicity test demonstrated the presence of both direct and indirect acting muta-

gens (TA-100, TA-98 and TA-1538). The addition of liver enzymes to the assay decreased the response in TA-98 and TA-100 and increased the response in TA-1538 in all samples tested. Similarities in the slopes of the dose-response curves obtained for the extracts in the three tester strains suggest that, within the sensitivity of the assay, no differences in mutagenicity due to the three filter types existed.

35608 (LMF—69, pp 567-570) **Heat degradation studies of solar heat-transfer fluids. II.** Henderson, T.R.; Clark, C.R.; Marshall, T.C.; Hanson, R.L.; Hobbs, C.H. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Destructive distillation of solar heat-transfer fluids was conducted to determine the types of pyrolytic products which might be formed in solar collectors under conditions of stagnation or malfunction. These studies showed dehydration products were formed from glycols and glycerol with ethylene oxide or propylene oxide being minor products. A petroleum heat-transfer fluid with high aromatic content exhibited distillation fractions enriched in quinolines or isoquinolines and their methylated derivates. Fractionation of this aromatic heat-transfer fluid showed that the basic fraction of the unheated fluid contained aza-arenes and was mutagenic in the Salmonella mutagenicity bioassay. Gas chromatography/mass spectroscopy showed that the basic fraction from the unheated heat-transfer fluid also contained benzoquinolines which were lacking in heat-degraded samples of the same fluid. A simple extraction procedure involvin preliminary extraction of basic and acidic fractions allowed subsequent removal of aromatic hydrocarbons. Fractionation of solar fluids was found to be necessary for both GC/MS analysis and Ames bioassay, in order to obtain good mass spectra of minor components and in order to detect mutagenic activities in the presence of hydrocarbons which were toxic to the test bacteria.

35609 **Effects of wastewater sludge and its detergents on the stability of rotavirus.** Ward, R.L. (Sandia Labs., Albuquerque, NM); Ashley, C.S. *Appl. Environ. Microbiol.;* **39**: No. 6, 1154-1158(Jun 1980).

Wastewater sludge reduced the heat required to inactivate rotavirus SA-11, and ionic detergents were identified as the sludge components responsible for this effect. A similar result was found previously with reovirus. The quantitative effects of individual ionic detergents on rotavirus and reovirus were very different, and rotavirus was found to be extremely sensitive to several of these detergents. However, neither virus was destabilized by nonionic detergents. On the contrary, rotavirus was stabilized by a nonionic detergent against the potent destabilizing effects of the ionic detergent sodium dodecyl sulfate. The destabilizing effects of both cationic and anionic detergents on rotavirus were greatly altered by changes in the pH of the medium.

35610 **Groups tackle synfuel carcinogen problems.** *Chem. Eng. News (Wash., D.C.);* **58**: No. 15, 31-32(14 Apr 1980).

Work at Oak Ridge National laboratory on petroleum substitutes is briefly reported. The neutral fractions of the substitutes are the largest contributors to mutagenicity of the whole material as measured by the Ames test, but this is because the neutral fractions are present in large amounts. The alkaline constituents have a higher specific activity than that of the neutral fractions. Azaarenes and aromatic primary amines, particularly polycyclic aromatic primary amines, are responsible for the mutagenicity, it is thought. Studies of SRC-II liquids at a US Department of Energy laboratory indicate that hydrotreating can reduce their mutagenicity substantially.

PLANTS

35611 (PB—80-122484) **A gas-exchange system for assessing plant performance in response to environmental stress.** Taylor, G.E. Jr; Tingey, D.T. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Oct 1979. 25p. NTIS, PC A02/MF A01.

Anthropogenic stresses are increasingly common as environmental factors affecting the performance of plants in both natural and agro-ecosystems. There is a need to determine how these stresses may influence vital physiological processes in plants. This report documents the design, construction and performance of a whole-plant, gas-exchange system that can accurately monitor gas flux (e.g., carbon dioxide, water vapor, pollutants) between plants and the atmospheric environment. From these data, rates of key physiological processes--photosynthesis, transpiration, gaseous uptake and emission--can be assessed. Example studies are reported on the uptake of sulfur dioxide by plants and emissions of monoterpenes from plants.

INVERTEBRATES

REFER ALSO TO CITATION(S) 35642

VERTEBRATES

REFER ALSO TO CITATION(S) 35540, 35598, 35602, 35604, 35649

35612 (CONF-8006117—2) **Multistage skin tumor promotion: involvement of a protein kinase.** Mamrack, M.; Slaga, T.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01.

From Workshop on biological carcinogenesis; Detroit, MI, USA (11 Jun 1980).

Current information suggests that chemical carcinogenesis is a multistep process with one of the best studied models in this regard being the two-stage carcinogenesis system using mouse skin. The effects of several carcinogens and tumor promoters in various sequences of application were studied to examine the nature of the process. The actions of several tumor inhibitors were compared. (ACR)

35613 (COO—3139-37) **Embryo culture in teratological surveillance and serum proteins in development. Progress report, 1979-1980.** Klein, N.W. (Connecticut Univ., Storrs (USA). Dept. of Animal Genetics). Jul 1980. Contract AS02-76EV03139. 11p. NTIS, PC A02/MF A01.

Research progress for the period 1979-1980 is reported. The feasibility of using rat embryo cultures to test the teratogenic activity of serum was studied. The mechanisms regulating the synthesis of serum proteins were investigated. (ACR)

35614 (LMF—69, pp 224-230) **Deposition of surrogate diesel aerosols in Beagle dogs.** Wolff, R.K.; Kanapilly, G.M.; DeNee, P.B.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Deposition and retention of surrogate diesel aerosols were studied in 20 Beagle dogs. Ultrafine chain aggregate aerosols of insoluble $^{67}Ga_2O_3$ in the 0.1 μm size range were generated by heat treatment of ^{67}Ga-tetramethylheptanedione. Aerosol characterization was done using electron microscopy, diffusion battery and electrical aerosol analyzer measurements. The diffusion equivalent diameter of the aerosol was 0.06 μm and the volume median diameter was 0.10 μm with a geometric standard deviation of 1.6. Primary particles from which the aggregates were formed were 0.01-0.02 μm in diameter. Whole-body counting and gamma camera imaging were used to measure deposition. Total deposition in the whole body was 33 +- 16% (mean +- SD) of the inhaled particles; 82 +- 13% of this material was deposited in the lung. Retention studies showed that 77 +- 3% of the material deposited in the lung was in the pulmonary region. Thus, 21% of the inhaled particles were deposited beyond ciliated airways in alveolar areas. The deposition in the deep lung has important implications for health-risk assessments of diesel exhaust emissions.

35615 (LMF—69, pp 415-419) **Long-term retention of monodisperse and polydisperse particles inhaled by Beagle dogs, rats and mice.** Snipes, M.B. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This study was designed to define the long-term retention of inhaled, spherical, laboratory-producted particles in mice, rats and Beagle dogs. Three monodisperse aerosols (0.6, 1.5 and 3.0 μm aerodynamic diameter) and a polydisperse aerosol (≃ 1.5 to 2.0 μm activity median aerodynamic diameter, geometric standard deviation ≃ 2.0) were used for this study. The aerosols were labeled with ^{134}Ce to provide ease of external counting and analysis of particle distribution patterns. The study will provide data for long-term retention to 920 days after exposure for rats and mice and for 9 years after exposure for Beagle dogs. Emphasis is being placed on the effect of particle size on long-term retention. All of the animals have been exposed; results indicate that dogs deposited 50 to 70% of the initial body burden in the lung and rodents deposited 6.5 to 36%. The lung deposition fractions were highest for the smaller particle sizes. Lung retention for the first year after exposure was represented by a single-component exponential expression in dogs and a two-component expression in rodents. For all animals the 0.6 μm AD particles were cleared faster than the larger ones, and dogs retained particles to a greater degree than did the rodents.

35616 (LMF—69, pp 420-423) **Lung retention of 3, 9 and 15 μm particles in the rat after intratracheal instillation.** Snipes, M.B.; Clem, M.F. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Rats were given 3, 9 and 15 μm particles of polystyrene latex by intratracheal instillation. Results of retention measurements provided comparative data for lung retention of these large particles for 106 days after exposure. Long-term retention half-times for the 3, 9 and 15 μm particles, respectively, were 69 days (50% of the particles), 580 days (75% of the particles) and infinite (85% of the particles). Particles as large as 15 μm, while having a low probability

for deposition in the lung by inhalation, could be retained indefinitely. Such tenacious retention could yield long-term, high chemical or radiation dose rates to focal areas in the lung.

35617 (LMF—69, pp 424-428) **Regional deposition of ^{14}C-benzo(a)pyrene in rat lung following inhalation.** Mitchell, C.E.; Tu, K.W. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Male Fischer 344 rats inhaled ^{14}C-benzo(a)pyrene aerosols (300 to 500 μg/l; 1 to 2 μm AMAD) for 1 hour. Animals were sacrificed immediately after exposure and lung lobes and lung lobe section were obtained and assayed for radioactivity. The highest concentration of radioactivity was found in the right apical lobes and in the distal regions within the lobes. These studies suggest that cells in the alveolar zone may receive higher levels of inhaled polycyclic aromatic hydrocarbons (PAH) and thus may show early signs of toxicity from inhaled PAH.

35618 (LMF—69, pp 429-435) **Deposition and retention of a hydrophobic vapor (ferrocene) in rats.** Dahl, A.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Ferrocene vapor labeled with iron-59 was administered to rats by inhalation. About 10% of the inhaled vapor was deposited in the lungs and 25% was deposited in the upper respiratory tract. It appears that ferrocene is a useful model for organic vapors with similar physicochemical properties and may be one of many organometallics useful as surrogates in determining deposition patterns for compounds which themselves are difficult to use in deposition experiments. The ^{59}Fe was retained in the nasal or pulmonary areas for long periods. Considerations of patterns of retention and the biochemistry of ferrocene indicate that chronic effects may result from inhalation of this compound and therefore the current threshold limit value for ferrocene is probably too high.

35619 (LMF—69, pp 436-441) **Retention and tissue distribution of inhaled selenious acid and elemental selenium aerosols in Beagle dogs.** Weissman, S.H.; Cuddihy, R.G. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The tissue distribution and retention of inhaled selenious acid and elemental selenium aerosols were studied as representative of selenium aerosols produced in fossil fuel combustion. Beagle dogs were given 20 to 60 μg Se/kg body weight by inhalation or by instillation into the upper respiratory tract or stomach. Virtually all of the inhaled selenious acid aerosol was rapidly absorbed into the blood from the lung. The long-term component of the whole-body retention function for inhaled selenious acid had a half-life of about 30 days and accounted for 17% of the initial selenium deposited. Selenium that was absorbed into the blood was translocated mainly to the liver, kidney and pelt. Long-term retention was primarily in the liver, pelt and blood. Long-term whole-body retention of inhaled Se^0 had a half-life of about 40 days and accounted for 13% of the initial selenium deposited. The internal organ distribution of inhaled selenium metal and selenious acid aerosols was similar except more selenium was retained in the lungs of animals inhaling selenium metal aerosols.

35620 (LMF—69, pp 442-447) **Simulation model for describing the metabolism of inhaled and ingested selenium compounds.** Burkstaller, M.A.; Cuddihy, R.G.; Griffith, W.C.; McClellan, R.O. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The metabolism of one trace element, selenium, was studied in rats after inhalation and ingestion of different chemical forms. A simulation model of selenium metabolism was developed from organ distribution and retention data obtained from these studies. Predictions of the model for the uptake and organ retention of selenium from the environment were compared to measured organ burdens in humans. Results indicate that inhalation of selenium compounds present in urban atmospheres does not contribute significantly to the human body burden of selenium.

35621 (LMF—69, pp 448-451) **Metabolism of selenium-containing aerosols by rats. Final results.** Burkstaller, M.A.; Cuddihy, R.G. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Absorption of selenium compounds from upper respiratory and gastrointestinal tracts was studied in Fischer 344 rats. Selenious acid was absorbed more completely from both regions than was elemental selenium. Significantly more activity appeared in the feces of animals that received elemental selenium by gavage compared to animals receiving selenious acid. Results indicate that when selenium aerosols deposit in the upper respiratory tract, twice as much selenium dioxide will be absorbed into the general circulation than elemental selenium.

35622 (LMF—69, pp 452-455) **Specificity of cation uptake from pulmonary lavage fluid in the Syrian hamster.** Henderson, R.F.; Henderson, T.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The airways of the Syrian hamster lung were found to remove certain cations preferentially from an isotonic glucose solution in the airways. Two examples of cations which were preferentially removed from solution (Cd^{++} and Pb^{++}) were studied further and the uptake was found to be a saturable event, with higher fractions of the cations retained at lower concentrations of the cation. The uptake could be prevented by EDTA but not by sodium citrate. The concentration required for 50% uptake from solution into the lung was ~ 6.5×10^{-5} M for Pb^{++} and ~ 8.5×10^{-6} M for Cd^{++}.

35623 (LMF—69, pp 456-461) **Isolation of a low molecular weight cadmium-binding protein from Syrian hamster lung.** Benson, J.M.; Henderson, R.F. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

A low molecular weight cadmium binding protein has been isolated from Syrian hamster lung. The protein elutes from a Sephadex G-75 column with V/sub e//V_0 (1.64 to 1.98) characteristic of metallothionein-like proteins and has an estimated molecular weight of 15,000. Small amounts of this protein exist in the unexposed lung, but biosynthesis of additional protein is initiated by exposure of lung to Cd^{++}, as indicated by incorporation of ^{14}C-cystine following exposure of animals to $CdCl_2$ by bronchopulmonary lavage. The Cd-binding protein does not appear to bind Cr^{+3}, Ni^{++} or Se^{+4}. A cadmium-binding protein in lungs of this species may be responsible for the prolonged retention of Cd in lung following pulmonary exposure of hamsters to $CdCl_2$.

35624 (LMF—69, pp 462-468) **Deposition and clearance of sulfuric acid mist in rats, guinea pigs and dogs.** Dahl, A.R. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Beagle dogs and guinea pigs were exposed nose-only to ^{35}S-labeled sulfuric acid mists. Sulfuric acid droplets with mass median aerodynamic diameters of 1 μm were deposited in almost equal amounts in the pulmonary region and in the upper respiratory tracts of Beagles. In guinea pigs a greater proportion of the deposited sulfuric acid was found in the deep lungs than in the upper respiratory tract. An interspecies comparison of clearance rates for sulfuric acid was studied in dogs, guinea pigs and rats. In all species pulmonary clearance was rapid compared to upper respiratory tract clearance. An apparent effect on total deposition as a function of sulfuric acid aerosol concentration or size was found in older guinea pigs.

35625 (LMF—69, pp 469-472) **Retention and fate of sulfur compounds deposited in the respiratory tract of rats.** Dahl, A.R.; Furst, G.M.; Hahn, F.F. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Autoradiographs of histologic sections indicated that 48 hours after radiolabeled sulfite was administered to rats by intratracheal instillation, the sulfite was retained in the arteries, veins and walls of airways. Identical experiments with labeled sulfate ion showed no sites of concentration of label in the lung.

35626 (LMF—69, pp 479-482) **Effect of anesthetic agents on lavage fluid parameters used as indicators of pulmonary injury.** Henderson, R.F.; Lowrey, J.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The effect of the anesthetic agent used in the sacrifice of animals in in vivo pulmonary toxicity screening tests has been tested in Fischer 344 rats and in Syrian hamsters. Using animals sacrificed by cervical dislocation with no anesthesia as a baseline, we found that CO_2 as an anesthetic caused the greatest perturbance of baseline lavage fluid and tissue parameters normally used in the screening tests. Sodium pentobarbital given i.p. caused similar changes in the baseline values as did CO_2, but to a lesser degree. Halothane anesthesia caused the least perturbance in the screening test parameters and we will continue to use this anesthetic in in vivo pulmonary toxicity tests.

35627 (LMF—69, pp 486-490) **Immunogically-mediated respiratory function responses to intratracheally-instilled anitgen in the Fischer 344 rat.** Likens, S.A.; Mauderly, J.L.; Bice, D.E. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

It is useful to have animal models of human respiratory diseases to assess the effect of these diseases on responses to airborne pollutants. In an effort to develop such models, a study was conducted to determine if sensitized Fischer 344 rats, when challenged by airway antigen, would respond with an immediate, asthma-like reaction (Type I response) or with a delayed response such as that seen

in hypersensitivity pneumonitis (Types III and IV responses). Rats were immunized with intraperitoneal injections of ovalbumin, and Bordetella pertussis was used as an adjuvant. The animals were challenged 30 days after immunization with an intratracheal instillation of ovalbumin and pulmonary function measurements were performed 10 minutes and 2 to 3 days after challenge. The subjects showed little functional change 10 minutes after challenge; however, 2 to 3 days later marked functional, morphological and clinical changes had occurred. It was concluded that Types III and IV hypersensitivity reactions were responsible. This lung reaction probably represents a model of hypersensitivity pneumonitis.

35628 (LMF—69, pp 491-494) **Response of rat lung cells to intratracheal instillation of BCG.** Felicetti, S.A.; Brooks, A.L.; Hackett, N.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This study investigated the cytokinetic response of rat lung cells to intratracheally deposited, heat-killed Bacillus Calmette Guerin (BCG). Rats were sensitized to BCG by footpad injection of 100 μ grams BCG in Freund's incomplete adjuvant (3 weeks prior to intratracheal challenge) or received no sensitizing treatment. Sensitized and unsensitized rats were sacrificed 12 hours to 26 days after challenge. Prior to sacrifice, animals were injected with ^{3}H-thymidine. Cell populations recovered from the left side of the lung by bronchopulmonary lavage showed an initial influx of polymorphonuclear cells followed by an increase in mononuclear cells which peaked at 5 days. At all times more cells were recovered from sensitized than from nonsensitized animals. Analysis of autoradiographs of lung sections showed on initial alveolitis which resolved into granulomatous pneumonia. Proliferating mononuclear cells were found within the granulomas. Proliferating Type II epithelial cells were found on the periphery of the lesion and preliferation Clara cells were found within small bronchioles. In conclusion, this study of the cytokinetic response of cells in the lung to pathogenic material provides the baseline information for evaluation of the response of a lung with pre-existing disease to inhaled environmental pollutants.

35629 (LMF—69, pp 495-497) **Cellular immunity induced by lung immunization of Fischer 344 rats.** Bice, D.E.; Schnizlein, C.T. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

This study describes immunologic responses in the lung lavage cells of rats immunized by intratracheal instillatin of BCG-sheep red blood cell (SRBC) suspensions. At 4 through 19 days after immunization, the antigen-specific inhibition of pulmonary alveolar macrophage migration was evaluated. On days 11 through 19 sufficient antigen-sensitive T-lymphocytes were present in the lavage cell population to inhibit the migration of the pulmonary alveolar macrophages. These results indicate that lymphoid cells responsible for cellular immunity are found in the lung after intratracheal instillation of BCG-SRBC suspensions.

35630 (LMF—69, pp 498-501) **Effect of pulmonary exposure to benzo(a)pyrene and NO_2 on the immune response of the lung evaluated by intraperitoneal immunization.** Schnizlein, C.T.; Bice, D.E. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Lung exposure to 1 mg benzo(a)pyrene (BaP) or 26 ppM NO_2 for 24 hours elevates the immune response in the lung-associated lymph nodes (LALN) to particulate antigen deposited into the lung if animals are immunized immediately after exposure. To determine if the alterations causing these changes took place in the lung or in the LALN, we immunized rats with 1 x 10^8 sheep red blood cells (SRBC) intraperitoneally which allowed the antigen to reach the LALN without first being handled by the lung clearance mechanisms. We immunized rats at various times relative to BaP or NO_2 lung exposure and measured the number of antibody-forming cells (AFC) in the LALN, spleen and cervical lymph nodes /7 days later. The BaP-exposed rats had a significantly increased number of antigen-specific IgM and IgG AFC in their LALN when they were immunized immediately after BaP instillation. In contrast, there was no significant difference in the number of AFC in the LALN from NO_2-exposed or sham-exposed rats. We concluded that the BaP was probably retained by the LALN and damaged the immunological function of these nodes, whereas the NO_2-induced damage was confined to the lung.

35631 (LMF—69, pp 506-510) **Effect of 0.3 and 0.9 μm sulfuric acid aerosols on tracheal mucous clearance in Beagle dogs.** Wolff, R.K.; Muggenburg, B.A.; Silbaugh, S.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Tracheal mucous clearance was measured in eight Beagle dogs following 1-hour exposures to sulfuric acid mist with particle sizes of 0.3 μm and 0.9 μm mass medianaerodynamic diameter (MMAD). Significant alterations in clearance were observed after exposures to the 0.9 μm MMAD aerosols at concentrations of 1.0 and 0.5 mg/m^3. However, there were no significant changes following exposures to the 0.3 μm MMAD aerosols at concentrations of 1.0 or even 5.0 mg/m^3.

35632 (LMF—69, pp 511-514) **Comparative measurements of tracheal mucous clearance in rats, guinea pigs, rabbits and dogs.** Felicetti, S.A.; Wolff, R.K.; Muggenburg, B.A. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Tracheal mucous clearance was measured in rats, guinea pigs, rabbits and dogs to study species difference in clearance rates. One to ten microliters of /sup 99m/Tc-macroaggregated albumin (MAA) were instilled in the distal trachea through an endotracheal tube in rats, rabbits and dogs and by tracheostomy in guinea pigs. All animals were anesthetized with inhaled halothane, the material instilled and the animal allowed to recover immediately in restrainers. Clearance was measured by a slit-collimated NaI scanner in rats and guinea pigs and by gamma camera scintiphotos in rabbits and dogs. Of the originally deposited material, 83 +- 23%, 81 +- 22% and 70 +- 20% remained at the deposition site in rats, guinea pigs and rabbits, respectively, at 1 hour after deposition. In the dogs, a mean of 14 +- 12% remained at the original site of deposition after 25 minutes. Mean leading edge velocities of the /sup 99m/Tc as the activity advanced proximally were 1.9 +- 0.7, 2.7 +- 1.4, 3.2 +- 1.1 and 9.8 +- 2.1 mm per minute for rats, guinea pigs, rabbits and dogs, respectively. Not only was the radioactivity cleared more rapidly and more completely in dogs than in the other species, but clearance patterns differed qualitatively. In dogs, the material moved as a few discrete boluses, whereas in the other species, the leading edge of the radioactive bolus spread proximally.

35633 (LMF—69, pp 515-518) **Factors affecting the pulmonary response of the guinea pig to sulfuric acid aerosols.** Silbaugh, S.A.; Macken, C.A.; Johnson, W.K. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Our previous studies hav suggested that the Hartley guinea pig reacts with an essentially all-or-none airway constrictive response when acutely exposed to sulfuric acid aerosols. This report compares pre-exposure pulmonary function values in responsive and nonresponsive animals exposed to 24 or 48 mg/m^3 sulfuric acid. Responsive guinea pigs had higher pre-exposure transpulmonary pressures and total pulmonary resistance values and lower dynamic lung compliance values than nonresponsive animals. Variations in tidal transpulmonary pressure excursions were correlated ($P < 0.005$) with minute volume in nonresponsive animals, while transpulmonary pressures were correlated ($P < 0.05$) with total pulmonary resistance in responsive animals. Our results suggest that the guinea pig's sensitivity to sulfuric acid-induced airway constriction is related to detectable pre-exposure factors.

35634 (LMF—69, pp 519-523) **Effect of H_2SO_4 and NO_2 on airway responsiveness of the guinea pig.** Silbaugh, S.A.; Macken, C.A.; Mauderly, J.L. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

We examined the capacity of nitrogen dioxide gas and sulfuric acid aerosol to alter the airway sensitivity of guinea pigs to histamine. Guinea pigs were exposed for 1 hour to sulfuric acid (4 to 40 mg/m^3), nitrogen dioxide (7 to 146 ppM), or room air (controls). A standardized histamine challenge test was performed for each animal prior to exposure and at 0, 2 and 19 hours after exposure. For each sample period, a measure of the amount of histamine aerosol required to produce a 50% decrease in pre-exposure dynamic compliance was used as an index of airway sensitivity. Nitrogen dioxide-exposed animals exhibited increased histamine sensitivities immediately after exposure and the magnitude of response was concentration dependent. Animals with small increases in histamine sensitivity returned to control values by 2 hours after exposure, but more severely affected animals remained more sensitive than controls at 2 and 19 hours after exposure. Animals exposed to sulfuric acid exhibited major increases in sensitivity only at concentrations of 19 mg/m^3 or greater and only if labored breathing developed during exposure. Both NO_2 and H_2SO_4 alter airway sensitivity, but apparently by different mechanisms.

35635 (LMF—69, pp 524-528) **Early indicators of pulmonary damage in Syrian hamsters exposed to NO_2.** DeNicola, D.B.; Rebar, A.H.; Henderson, R.F. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Syrian hamster were exposed to various concentrations of nitrogen dioxide (NO_2) gas for 48 hours. Areas of investigation included: measuring the biochemical and cytologic content of pulmonary lavage fluids, measuring the biochemical content of pulmonary tissue homogenates, and histopathologic evaluation of pulmonary tissues. The pathology induced by NO_2 was characterized by a

multifocal, necrotizing terminal bronchiolitis with a dose-dependent increase in severity of the lesions observed. Dose-dependent alterations in biochemical and cytologic contents of lavage fluids and biochemical content of lung tissues were also observed. Cytologic alteration of lavage fluids proved to be the most sensitive indicator of this form of pulmonary damage. The lavage fluid profile for NO_2-induced pulmonary injury was distinct from those of previously investigated acute inhalation injury models.

35636 (LMF—69, pp 529-532) **Response of Syrian hamsters to acute exposure to an FBC fly ash in the presence and absence of NO_2.** DeNicola, D.B.; Rebar, A.H.; Henderson, R.F. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Syrian hamsters were exposed to fly ash collected from a fluidized bed coal combustor in the presence and absence of NO_2 to determine (1) the response of the animals to acute exposure to fly ash and (2) the effect of the ash on the pulmonary toxicity of NO_2. Exposure to the ash was for 6 hours (fly ash alone) or for the first 6 hours of a 48-hour exposure to NO_2. Response of the animals was measured by three endpoints: the biochemical and cytological contents of the airway fluids, the histopathological state of the lung tissue and the LC_{50} for the animals exposed to NO_2 with and without fly ash. The animals showed no toxic responses to the fly ash itself, but the ash reduced th LC_{50} for NO_2 by 15%. Fly ash may act to potentiate the toxicity of other pollutants associated with fossil fuel combustion.

35637 (LMF—69, pp 547-549) **Dissolution of sodium from glass fibers: effect on quantitation of fibers in the lung.** Griffis, L.C. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

A method for quantitation of glass fibers in the lung by analysis of acid-insoluble sodium may be complicated by the loss of sodium from the fibers. The dissolution of sodium from glass fibers prepared from commercial insulation or experimental microfiber insulation was measured in distilled water or 0.1 M HCl for 7 days. Dissolution was determined by measuring the sodium content of the water or acid periodically by atomic adsorption spectroscopy. The appearance of soluble sodium in both solvents increased linearly for 4 days and then decreased. Less than 3.5% of the total sodium in the commercial fibers was dissolved in either water or acid after 7 days. Almost 50% of the total sodium in the smaller microfibers was in solution after 7 days in acid but less than 5% was in solution after the same time in water. The lung microenvironment should be less severe than 0.1 M HCl so the fraction of sodium leached from inhaled microfibers should be smaller. The results indicated that the sodium in lung tissue after brief acid washing to remove biologic sodium should be a satisfactory measure of the quantity of glass present. This approach appears to be valid for both commercial insulation fibers for several days after exposure and for determining the initial lung burdenof microfibers after short inhalation exposures.

35638 (LMF—69, pp 563-566) **Toxicological assessment of seven solar heat-transfer fluids.** Marshall, T.C.; Clark, C.R.; Brewster, D.W.; Merickel, B.S. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

Seven commercially available heat transfer-fluids (ethylene glycol, H-30, Norkool, Nutek-820, SF-96, Solaryard P, Thermia C and UCAR 17) were evaluated for acute oral toxicity in female rats and for dermal and ocular irritability in female rabbits. Mutagenicity testing was performed with the Ames Salmonella assay. Oral LD_{50}'s ranged from 4.6 g/kg for ethylene glycol to greater than 24 g/kg for the hydrocarbon and silicone oils and the propylene glycol product. Norkool and UCAR 17, both ethylene glycol-based mixtures, showed higher LD_{50}'s than pure ethylene glycol. None of the fluids were found to be mutagenic or to cause more than a slight ocular or dermal irritation.

35639 (LMF—69, pp 571-574) **Pharmacokinetics of ethylene glycol following intravenous administration to rats.** Marshall, T.C. Dec 1979.

In Inhalation Toxicology Research Institute. Annual report, October 1, 1978-September 30, 1979.

The pharmacokinetics and fate of ^{14}C-ethylene glycol administered intravenously (20, 200, 1000 and 2000 mg/kg) were studied in female Fischer 344 rats. The disappearance of ^{14}C from blood occurred in an initial rapid phase (T/sub 1/2/ = 5 hr) followed by a longer elimination phase (T/sub 1/2/ = 48 hr). No dose-related trends in blood clearance kinetics were demonstrated. The primary routes of elimination were via expired air as ^{14}C-labeled carbon dioxide and through the urine. The amount of $^{14}CO_2$ elimination relative to urinary excretion of radiocarbon decreased as the dosage increased. These data suggest that as the oxidative metabolic pathway for ethylene glycol was saturated at higher dosages, a compensatory mechanism through the renal pathway effectively cleared the toxicant from the blood.

35640 **Isolation and partial characterization of native metallothionein in fetal rabbit liver.** Waalkes, M.P.; Bell, J.U. (West Virginia Univ. Medical Center, Morgantown). *Life Sci.;* **27**: No. 7, 585-593(18 Aug 1980).

The endogenous zinc content of hepatic cytosol in the term fetal rabbit was found to be three-fold higher than corresponding maternal levels. Following gel-filtration, the bulk of this zinc was found to be associated with a peak, not detectable in the maternal cytosol, having a relative elution volum similar to that of cadmium-induced metallothionein. In vitro addition of increasing amounts of cadmium to the fetal cytosol prior to gel-filtration caused progressive displacement of endogenous zinc from the peak, selective cadmium binding and eventual cadmium saturation. An ion-exchange chromatography disclosed two distinct peaks, corresponding to the two cadmium-containing peaks detected in the cytosol from cadmium-induced animals. SDS-polyacrylamide gel electrophoresis of purified protein also revealed the existence of two bands in both the fetus and induced adult. Results indicate the presence of endogenous metallothioneins in the hepatic cytosol of the normal term rabbit fetus which are similar to the metallothioneins which appear in the adult hepatic cytosol following exposure to cadmium.

35641 **Enhanced near-ultraviolet light sensitivity induced by coal combustor effluents in cultured mammalian cells.** Lankas, G.R.; Haugen, D.A.; Elkind, M.M. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *J. Toxicol. Environ. Health;* **6**: No. 4, 723-729(Jul 1980).

The cytotoxicity of radiation from Westinghouse sun lamps (principal emission ~ 290 to 340 nm) was enhanced by treatment of cells with nontoxic concentrations of condensate from the gaseous effluent from a pressurized, fluidized-bed coal combustor. The effect was similar to the photoenhanced cell killing induced by nontoxic concentrations of 7,12-dimethylbenz[a]anthracene, a carcinogenic derivative of substances produced by incomplete combustion of fossil fuels. Furthermore, light-dependent cell killing requiring the presence of the condensate was observed even when the sun lamp emission was filtered (principal emission ~ 300 to 340 nm) to eliminate cell killing due to near-ultraviolet light alone, or when a black light near-ultraviolet source (emission maximum, 365 nm) was used. It is suggested that coal combustor effluents may act synergistically with the short-wavelength component of sunlight.

35642 **Mercury accumulation in fish and invertebrates of the North Fork Holston River, Virginia and Tennessee.** Hildebrand, S.G.; Strand, R.H.; Huckabee, J.W. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Environ. Qual.;* **9**: No. 3, 393-400(Jul 1980).

Both total and methylmercury accumulation were investigated in fish and invertebrates in the North Fork of the Holston River below a currently inactive chloralkali plant to quantify the extent of contamination, to determine what proportion of the variance in mercury concentration in fish can be explained by mercury concentration in water, sediment, benthic invertebrates, and to determine what proportion of mercury concentration in benthic invertebrates can be explained by mercury concentration in water and sediment. Fish species [rock bass (Ambloplites rupestris) and hog sucker (Hypentelium nigricans)] and benthic invertebrates were collected from stations above and below the plant, and axial muscle (fish) or whole animal (invertebrates) was analyzed for total mercury by flameless atomic absorption and for methylmercury by gas chromatography. The relation of total mercury concentration to fish weight and factors affecting mercury concentration in fish and invertebrates were examined through regression analysis. Total mercury concentration in fish and benthic invertebrates decreased with distance below the plant. Significant linear regressions of total mercury concentration on fish weight were observed for some, but not all, samples examined. Mercury in the methyl form comprised 91.7% of total mercury in fish analyzed, while approximately 50% of the mercury in invertebrates was methylmercury.

MAN

REFER ALSO TO CITATION(S) 35543

35643 (PB—80-108582) **Biochemical changes in humans upon exposure to sulfuric acid aerosol and exercise. Research report.** Chaney, S.; Blomquist, W.; Muller, K.; Goldstein, G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Aug 1979. 25p. NTIS, PC A02/MF A01.

A total of 18 human subjects were exposed to ambient air for four hours on the first day of exposure and to four hours of 100 micrograms/cu. m. (0.033 micromole) sulfuric acid aerosol exposed to four hours of ambient air on both exposure days. Six biochemical blood parameters were measured pre and post exposure: glutathione, lysozyme, glutathione reductase, serum glutamic oxaloacetic acid transaminase, serum vitamin E and 2,3-diphosphoglyceric acid. The results indicate no significant effect of one four hour exposure of humans to sulfuric acid aerosol (100 micrograms/cu. m.). One sig-

nificant effect did occur indicating an increase in glutathione reductase post exposure for both the control group and acid group. This report covers a period from October 23, 1978 to December 15, 1978, and work was completed as of May 1, 1979.

35644 (PB—80-119522) **Model for measuring the health impact from changing levels of ambient air pollution: mortality study. Final report.** Namekata, T.; Carnow, B.W.; Reda, D.J.; O'Farrell, E.; Marselle, J.R. (Illinois Univ., Chicago (USA). School of Public Health). Aug 1979. Contract EPA-68-02-2492. 78p. NTIS, PC A05/MF A01.

The major objective of this study is to answer the questions, Is a recent mortality decline in the city of Chicago caused by a decrease in the amount of major air pollutants such as suspended particulate and sulfur dioxide. Based on multiple regression analysis for the cross-sectional analysis, a percentage decrease in the age-adjusted death rates was estimated when a 25 percent reduction in TSP in Chicago for the period 1970-1975, was applied to the models developed. The age-adjusted death rate for non-accidental causes would be decreased by 5.36 percent (54.65 deaths per 100,000 persons) in Chicago. A percentage decrease in the death rates by cause was estimated to be 8.82 percent (all heart diseases), 6.42 percent (ischemic heart disease), 16.95 percent (other heart disease), 9.39 percent (diabetes mellitus), 20.13 percent (cirrhosis of the liver), 26.16 percent (emphysema) and 6.47 percent (other non-accidental causes). Models developed in daily analysis imply that there would be possible acute effects of daily air pollution concentrations (both SO2 and TSP, in addition to their interaction) on daily mortality changes (both all non-accidental causes and heart diseaes), controlling for weather and day-of-week effects.

35645 (PB—80-131428) **Potential atmospheric carcinogens, phase 1. Identification and classification. Interim report, September 1977-October 1978.** McMillin, C.R.; Mote, L.B.; DeAngelis, D.G. (Monsanto Research Corp., Dayton, OH (USA). Dayton Lab.). Jan 1980. Contract EPA-68-02-2773. 255p. NTIS, PC A12/MF A01.

A comprehensive literature search identified more than 125 high-volume chemicals having the potential of becoming airborne carcinogenic pollutants. Based on carcinogenicity and mutagenicity data, the pollutants were divided into three categories: probable carcinogens, possible carcinogens, and probable noncarcinogens. Additional data were collected for the possible and probable carcinogens including their annual production, emissions, atmospheric persistence, and relative mutagenic and carcinogenic potencies. The pollutants were then ranked on the basis of a calculated equivalent weight of benzo(a) pyrene emitted per year after 24 hours in the atmosphere. From the top portions of these two lists, 20 compounds, representing various chemical classes, were chosen for future analysis. A state-of-the-art review of the effect of cofactors on the carcinogenicity of chemicals was also completed. To locate optimum sampling sites in cities of interest, a series of carcinogen isopleths was generated. Using information such as the locations of stationary sources of carcinogenic pollutants, normalized wind direction and speed, and the height, temperature, and rate of flow of the sources, the probable locations of maximum carcinogenic pollution concentration were computed.

35646 (PB—80-802465) **Industrial health hazards due to atmospheric factors. Volume 2. August 1975-September 1978 (a bibliography with abstracts). Report for August 1975-September 1978.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 236p. NTIS PCN01/MF N01.

Industrial medicine, occupational diseases, health of miners, and the toxicological factors of various pollutants are topics covered by the abstracts of research reports in the bibliography. Some pollutants included are manganese, radon, silicon dioxide, explosives, asbestos, platinum, palladium, polyvinly chloride, nickel, pesticides, chromium, plastics, and vanadium. (This updated bibliography contains 236 abstracts, none of which are new entries to the previous edition.)

35647 (PB—80-802473) **Industrial health hazards due to atmospheric factors. Volume 3. October 1978-November 1979 (a bibliography with abstracts). Report for October 1978-November 1979.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Dec 1979. 68p. NTIS PCN01/MF N01.

The bibliography contains abstracts of research reports covering such topics as industrial medicine, occupational diseases, health of miners, and the toxicological factors of various pollutants. Some pollutants included are manganese, radon, silicon dioxide, explosives, asbestos, platinum, palladium, polyvinyl chloride, nickel, pesticides, chromium, plastics, and vanadium. (This updated bibliography contains 68 abstracts, 11 of which are new entries to the previous edition.)

35648 (PB—80-803695) **Environmental carcinogens. Volume 3. 1979 (a bibliography with abstracts). Report for January-December 1979.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Jan 1980. 179p. NTIS PC N01/MF N01.

The bibliography cites research reports on the identification, sources, and toxicity of environmental carcinogens. Included are studies on pesticides, fire extinguishing agents, environmental pollutants, food additives, radiation, and other known or suspected carcinogenic substances. (This updated bibliography contains 172 abstracts, none of which are new entries to the previous edition.)

35649 (UCRL—84593) **Sperm assays in man and other mammals as indicators of chemically induced testicular dysfunction.** Wyrobek, A.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jul 1980. Contract W-7405-ENG-48. 20p. (CONF-800323—3). NTIS, PC A02/MF A01.

From Symposium on the application of short-term bioassays in the fractionation and analysis of complex environmental mixtures; Williamsburg, VA, USA (21 Mar 1980).

Human sperm assays can be effective in identifying chemical agents that alter testicular function. Four human sperm assays are available - sperm density, motility, morphology, and the YFF test. Sperm assays have practical advantages over other approaches for assessing chemically induced changes in human testicular function, and they have been used in more than 60 different occupational, environmental, and drug-related chemical exposures. Studies of chemically induced sperm anomalies in other mammals have provided data on several hundred agents and encompass numerous species. The most widely used animal sperm assay is sperm morphology of mice. It is simple, quantitative, and sensitive to carcinogens, mutagens, and teratogens. The availability of both human and animal sperm assays provides a valuable link between human and animal studies which may be of potential benefit in assessing the heritable genetic risk associated with chemically induced sperm defects. Results from sperm assays may be used in conjunction with results from short term mutagenicity assays (those with definitive genetic endpoints) to identify those mutagens that may be active in the mammalian testes.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 35462, 35588, 35608, 35637, 35638, 35639

35650 (AD-A—078215) **Recent progress in electromagnetic absorption and dosimetry in biological systems. Interim report.** Olsen, R.G. (Naval Aerospace Medical Research Lab., Pensacola, FL (USA)). 21 Dec 1978. 26p. NTIS, PC A03/MF A01.

Dosimetry, as a subset of research in electromagnetic (EM) bioeffects, has made such rapid progress during the last decade that many scientific investigators are unaware of the present state-of-art. As a result, inadequate utilization of available technology is seen in much research currently in progress. Such research, conducted in the absence of sound dosimetry design, lacks credibility. This study provides a usable orientation in present and future dosimetric technology through a documentation of the swift progress in this area since 1969. The information contained in this report can assist researchers in making full use of the latest dosimetric techniques and devices to quantitatively establish the existence of observed effects. (Author)

35651 (PB—80-803935) **Biological effects of laser radiation. Volume 2. January 1978-January 1980 (citations from the NTIS data base). Report for January 1978-January 1980.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Jan 1980. 46p. NTIS PC N01/MF N01.

The bibliography cites reports on radiation injuries, permissible dosage, protective devices, and safety measures. Included are references on the pathology of eye lesions caused by lasers. (This updated bibliography contains 39 abstracts, 17 of which are new entries to the previous edition.)

35652 **Varied magnetic field, multiple-pulse, and magic-angle spinning proton nuclear magnetic resonance study of muscle water.** Fung, B.M. (Univ. of Oklahoma, Norman); Ryan, L.M.; Gerstein, B.C. *Biophys. J.*; **29**: No. 2, 229-236(Feb 1980).

The nuclear magnetic resonance linewidth of ^1H in water of frog muscle was studied as a function of magnetic field strength and angle of orientation. The results suggest that the observed spectra are dominated by demagnetization field anisotropy and dispersion, but a small static dipolar interaction of the order of a few hertz may be present. Data from line-narrowing, multiple-pulse experiments also indicate the presence of a small dipolar broadening.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 35072, 35646, 35647

35653 (CONF-800549—4) **Multiobjective location planning for primary medical services in rural Iowa.** Hillsman, E.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From 11. annual modeling and simulation conference; Pittsburgh, PA, USA (1 May 1980).

Developing location plans for primary medical services is a multiobjective location problem. In rural regions, plans must consider both the ability of a location to retain needed health care professionals and the accessibility of service center locations to the rural population. Using township level population data and a model of physician attrition, these objectives were incorporated into a location-allocation model and applied to rural Iowa.

35654 (PB—80-112253) **Administration of the Radiation Control for Health and Safety Act of 1968, Public Law 90-602, April 1, 1979. Annual report, 1 January 1978-31 December 1978.** (Bureau of Radiological Health, Rockville, MD (USA)). 1 Apr 1979. 85p. NTIS, PC A05/MF A01.

The Secretary of HEW is required by Subpart 3, Part F of Title III of the PHS Act; 42 USC 263 et seq. (P.L. 90-602) to submit an annual report to the President for transmittal to the Congress on or before April 1 on the administration of the Radiation Control for Health and Safety Act. The detailed information required to be included in the report is outlined in Section 360D of the PHS Act. The FDA, through its Bureau of Radiological Health has been delegated the authority for the day-to-day administration of the Act. This report covers the detailed operation of the Agency in carrying out that responsibility for calendar year 1978.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 34609, 34765

35655 (DOE/EV/13573—T1, pp Paper 10, 13 pages) **^{10}Be stratigraphies in the Pacific sediment cores back to 4 million years.** Tanaka, S. (Univ. of Tokyo, Japan). 1979.

In Natural radioactive isotopes of beryllium in the environment.

^{10}Be concentration variations were investigated in eight Pacific sediment cores. Beryllium was chemically separated from the sediment samples, and the beta activity of ^{10}Be was measured with low-level needle counters. The purpose of this work was to establish the ^{10}Be chronology during the past millions of years. This was done with the assumption of constant ^{10}Be precipitation, P, onto a sediment surface and of varying rate of sediment accumulation with time during the past 2.5 million years. Results indicate the global average of P values to be between two previously published estimated atmospheric production rates of 1.8×10^{-2} ^{10}Be atoms $cm^{-2}.sec^{-1}$ and 4.2×10^{-2} $atoms.cm^{-2}.sec^{-1}$. The ^{10}Be concentration variations back to 2.5 million years are within the limits of +- 30%, although a larger scatter can be seen during the period of 1 to 2.7 million years compared to the last one million years. In two cores taken from North Pacific basin, a catastrophically large change of more than an order of magnitude in ^{10}Be concentrations is seen at around 2.9 and 3.8 million years BP, respectively. This gives evidence of a drastic change of ^{10}Be flux or sedimentation rate during this period in the North Pacific. Possible causes for this variation are discussed. (JGB)

35656 (DOE/EV/13573—T1, pp Paper 11, 12 pages) **^{10}Be in the marine environment.** Ku, T.L. (Univ. of Southern California, Los Angeles). 1979.

From Natural radioactive isotopes of beryllium in the environment; New Haven, CT, USA (1-2 October 1979).

Applications of marine ^{10}Be as a geochronological tool and as an indicator of cosmic-ray intensity and/or geomagnetic field variations in the past are discussed. Summaries are made from the data available.

35657 (DOE/EV/13573—T1, pp Paper 13, 15 pages) **^{10}Be in polar glaciers: a tree ring analog for the entire Pleistocene.** Finkel, R. (Univ. of California, San Diego). 1979.

In Natural radioactive isotopes of beryllium in the environment.

The glacial ice holds a record of the past composition of the atmosphere and its trace constituents. One of the major impediments to the full utilization of this record is the lack of a technique for assigning a time scale to ice samples which are older than the ^{14}C limit of about 25,000 years. The possible use of ^{10}Be and ^{36}Cl, both as chronometer species for dating polar ice and as general tracers of geophysical and astrophysical processes during the Pleistocene, is discussed.

35658 (GJBX—169(80)) **Uranium potential of southwestern New Mexico (southern Hidalgo County), including observations on crystallization history of lavas and ash tuffs and the release of uranium from them. Final report.** Walton, A.W.; Salter, T.L.; Zetterlund, D. (Kansas Univ., Lawrence (USA). Dept. of Geography). Aug 1980. Contract AC13-76GJ01664. 184p. NTIS, PC A09/MF A01.

Geological environments present in southwestern New Mexico include thick sequences of sedimentary rock including limestone, conglomerates, sandstone, and shale: igneous intrusions with associated metal deposits; caldera centers, margins, and outflow facies; and basins with marginal faults and thick late Cenozoic sedimentary fillings. Predominant rock types are Paleozoic carbonates, Mesozoic terrigeneous rocks and carbonates, and Cenozoic volcanic rocks and basin-filling terrigeneous rocks. Consideration of information available in Preliminary Reconnaissance Reports and in Hydrogeochemical and Stream Reconnaissance Reports together with 347 new whole rock chemical analyses points to three areas of anomalous uranium abundance in Hidalgo County, New Mexico. The area has experienced three major periods of igneous activity in Phanerozoic time: one associated with the Laramide cycle of the Late Cretaceous and early Tertiary, mid-Tertiary cycle of silicic volcanism with abundant calderas, and a late Tertiary cycle of mafic volcanism. Silicic volcanic rocks are the most common exposed rock type in the area, and the most enriched in uranium (range, 0.4 to 19 ppM). The most likely source for any uranium ore-forming solutions lies with this cycle of volcanism. Solutions might have been introduced during volcanism or formed later by groundwater leaching of cooled volcanic rocks. Results indicate that groundwater leaching of cooled volcanic rocks was not an effective means of mobilizing uranium in the area. Study of several rhyolite lava flows indicates that they were emplaced in supercooled condition and may have crystallized completely at temperatures well below their liquids, or they may have warmed as crystallization released latent heat. Statistical comparison of the uranium concentration revealed no differences between vitrophyres and associated felsites.

35659 (UCRL—15270) **State-of-the-art for evaluating the potential impact of flooding on a radioactive waste repository.** (Geotechnical Engineers, Inc., Winchester, MA (USA)). 16 Jul 1980. Contract W-7405-ENG-48. 68p. NTIS, PC A04/MF A01.

This report is a review of the state-of-the-art for evaluating the potential impact of flooding on a deep radioactive-waste repository, namely, for predicting the future occurrence of catastrophic flooding and for estimating the effect of such flooding on waste containment characteristics. Several detrimental effects are identified: flooding can increase groundwater seepage velocities through a repository within the framework of the existing hydrologic system and thus increase the rate of radioactive-waste leakage to the biosphere; flooding may alter repository hydrology by reversing flow gradients, relocating sources of groundwater recharge and discharge, or shortening seepage paths, thereby producing unpredictable leakage; saturation of a vadose-zone repository during flooding can increase groundwater seepage velocities by several orders of magnitude; and flooding can damage repository-media containment properties by inducing seismic or chemical instability or increasing fracture permeability in relatively shallow repository rock as a result of redistributing in-situ stresses. Short-term flooding frequency and magnitude can be predicted statistically by analyzing historical records of flooding. However, long-term flooding events that could damage a permanent repository cannot be predicted with confidence because the geologic record is neither unique nor sufficiently complete for statistical analysis. It is more important to identify parameters characterizing containment properties (such as permeability, groundwater gradient, and shortest seepage path length to the biosphere) that could be affected by future flooding, estimate the maximum magnitude of flooding that could occur within the life of the repository by examining the geologic record, and determine the impact such flooding could have on the parameter values.

GEOPHYSICS

SEISMOLOGY AND TECTONICS

35660 (UCRL—15269) **State-of-the-art for evaluating the potential impact of tectonism and volcanism on a radioactive waste repository.** (Geotechnical Engineers, Inc., Winchester, MA (USA)). 16 Jul 1980. Contract W-7405-ENG-48. 83p. NTIS, PC A05/MF A01.

Most estimates of the time required for safe isolation of radioactive wastes from the biosphere range from 100,000 to 1,000,000 years. For such long time spans, it is necessary to assess the potential effects of geologic processes such as volcanism and tec-

tonic activity on the integrity of geologic repositories. Predictions of geologic phenomena can be based on probabilistic models, which assume a random distribution of events. The necessary historic and geologic records are rarely available to provide an adequate data base for such predictions. The observed distribution of volcanic and tectonic activity is not random, and appears to be controlled by extremely complex deterministic processes. The advent of global plate tectonic theory in the past two decades has been a giant step toward understanding these processes. At each potential repository site, volcanic and tectonic processes should be evaluated to provide the most thorough possible understanding of those deterministic processes. Based on this knowledge, judgements will have to be made as to whether or not the volcanic and tectonic processes pose unacceptable risk to the integrity of the repository. This report describes the potential hazards associated with volcanism and tectonism, and the means for evaluating these processes.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 34608

35661 (AD-A—078521/2) **Blast induced liquefaction potential. influence of unsaturated conditions. Final report 1 Mar 78-28 Feb 79.** Charlie, W.A.; Martin, J.P. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). 26 Sep 1979. 32p. NTIS, PC AA03/MF A01.

The phenomenon called blast induced liquefaction is examined. Blast induced ground motions which may cause liquefaction are categorized on the basis of wave form characteristics and motion types and compared to earthquake groundmotions. Prediction methods used in Russia, Europe and North America are reviewed. The influence of field tests on unsaturated subsurface soils in respect to liquefaction potential, porewater pressure increase, porewater pressure measurement, shock wave velocity and scaling factors are given. The occurrence, detection, and removal of entrapped gas are reviewed. Recent research has shown that the assumption of little or no soil property change may be non-conservative for certain saturated soil subjected to loadings from high explosive test events. Various indirect evidence indicates that blast induced liquefaction (a soil property change) may occur. Any attempt to correlate the results of blast-induced liquefaction with data obtained in conjunction with earthquake loadings must include the many differences between the two. However, important material property changes common to both seem to be pore-water pressures, shear strength, and relative density. The effect of soil type and magnitude and type of stress changes, induced by overpressure and direct induced ground motion, are also controlling factors. Until additional research is completed, loose saturated sands should be regarded as having a high blast-induced liquefaction potential. (Author)

35662 (AD-A—078618/6) **Seismic soil liquefaction at the waterfront. Final report oct 77-oct 78.** Forrest, J.B.; Ferritto, J.M. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). May 1979. 57p. NTIS, PC AA04/MF A01.

The vulnerability of waterfront facilities to earthquake-induced soil liquefaction has been demonstrated during several recent earthquakes. A liquefaction threat analysis conducted by the Navy has suggested, however, that reliable procedures for precisely evaluating the extent of this hazard to waterfront structures are not currently available. As a part of a program to remedy this problem, the earthquake-induced liquefaction potential at a coastal Naval installation was evaluated by means of cyclic triaxial testing of undisturbed soil samples. This study shows that for the particular sensitive soil tested, the resistance to liquefaction as determined by laboratory testing of undisturbed samples is considerably larger than that determined using correlations with in situ penetration resistance tests. Both dynamic split spoon driving resistance and quasi-static friction cone resistance were measured in the tests. Field evaluation techniques are discussed, and those considered most promising are noted. Several total stress and effective stress computer codes are discussed, with particular attention to those incorporating pore water dissipating mechanisms. Several example solutions from the literature are presented. (Author)

35663 (PNL—2864) **Identifying suitable piercement salt domes for nuclear waste storage sites.** Kehle, R.;. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 46p. NTIS, PC A03/MF A01.

Piercement salt domes of the northern interior salt basins of the Gulf of Mexico are being considered as permanent storage sites for both nuclear and chemically toxic wastes. The suitable domes are stable and inactive, having reached their final evolutionary configuration at least 30 million years ago. They are buried to depths far below the level to which erosion will penetrate during the prescribed storage period and are not subject to possible future reactivation. The salt cores of these domes are themselves impermeable, permitting neither the entry nor exit of ground water or other unwanted materials. In part, a stable dome may be recognized by its present geometric configuration, but conclusive proof depends on establishing its evolutionary state. The evolutionary state of a dome is obtained by reconstructing the growth history of the dome as revealed by the configuration of sedimentary strata in a large area (commonly 3,000 square miles or more) surrounding the dome. A high quality, multifold CDP reflection seismic profile across a candidate dome will provide much of the necessary information when integrated with available subsurface control. Additional seismic profiles may be required to confirm an apparent configuration of the surrounding strata and an interpreted evolutionary history. High frequency seismic data collected in the near vicinity of a dome are also needed as a supplement to the CDP data to permit accurate depiction of the configuration of shallow strata. Such data must be tied to shallow drill hole control to confirm the geologic age at which dome growth ceased. If it is determined that a dome reached a terminal configuration many millions of years ago, such a dome is incapable of reactivation and thus constitutes a stable storage site for nuclear wastes.

35664 (SAND—80-0392) **Creep healing of fractures in rock salt.** Costin, L.S.; Wawersik, W.R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

Fracture and healing experiments were performed on specimens of bedded salt from the Salado formation, southeastern New Mexico. Short rod specimens (100 mm in diameter) were loaded to failure in tension. During each test, a crack was initiated along the axis of the specimen. The fracture toughness of the salt was determined from the resulting load-crack opening displacement record. After the test, each specimen was pieced back together, jacketed and placed in a pressure vessel under hydrostatic pressure for several days. The confining pressure (10 to 35 MPa), temperature (22 to 100°C) and healing time (4 to 8 days) were varied to determine the effect of each on the healing process. Upon removal from the pressure vessel, each sample was retested and the toughness of the healed fracture was determined. Results show that the salt specimens regained 70 to 80% of their original strength under all conditions except at the lowest temperature and pressure where specimens regained only 20 to 30% of their original strength. It is suspected that the primary mechanism involved is creep of asperities along the fracture surface which forms an interlocking network. Thus, the healing pressure is probably the most significant variable.

35665 **Description and interpretation of metasomatic phase relations at high pressures and temperatures: 1. equilibrium activities of ionic species in nonideal mixtures of CO_2 and H_2O.** Walther, J.V.; Helgeson, H.C. (Univ. of California, Berkeley). *Am. J. Sci.;* **280**: No. 7, 575-606(Sum 1980).

Correlation of ionic activity diagrams incorporating explicit provision for solvation of aqueous species with temperature-X/sub CO_2/ diagrams depicting equilibrium among minerals and fluids in the system $CaO-MgO-SiO_2-HCl-CO_2-H_2O$ facilitates thermodynamic analysis of multivariant high pressure/temperature phase relations in siliceous dolomites. Comparative calculations indicate that solvation and nonideal mixing in the system CO_2-H_2O may have a dramatic effect on the equilibrium activities and total concentrations of ionic species in fluids coexisting with calc-silicate mineral assemblages. Under certain circumstances the concentration of calcium in these fluids probably exceeds by several orders of magnitude the concentration of magnesium, which may then be essentially conserved among solids during metasomatic reaction of the fluid phase with its mineralogic environment. Application of activity diagrams to metamorphic systems affords a comprehensive basis for correlating field and laboratory observations with fluid inclusion studies and the solution chemistry of metamorphic fluids at high pressures and temperatures.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 34583

PHYSICS RESEARCH

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

REFER ALSO TO CITATION(S) 35358

35666 (DOE/EV/13573—T1, pp Paper 1, 7 pages) **Cosmogenic production of ^{7}Be and ^{10}Be in the atmosphere.** O'Brien, K. (Dept. of Energy, New York, NY). 1979.

In Natural radioactive isotopes of beryllium in the environment.

Collisions of cosmic-ray particles with nuclei of the air result in the production of energetic secondary nucleons and mesons that in turn collide with other air nuclei to generate a cascade of hadrons through the atmosphere. After its collision with an energetic hadron, the nucleus will be in one or more fragments. Each of these collisions is called a star. About 1.4% of the time, one of the fragments associated with the star will be a ^{10}Be nucleus, and about 3% of the time, one of the fragments will be ^{7}Be. The energy spectrum incident on the earth was calculated in the electric field approximation. Ehmert potentials were varied from zero to 1000 MV to encompass the maximum range of solar activity. The geomagnetic field strength was allowed to range from 0.5 to 5 times the current value. The production rates of ^{7}Be and ^{10}Be were obtained by calculating the star density as a function of altitude and geomagnetic latitude in the atmosphere. The combined effect of solar modulation and geomagnetic field variation on world-wide star production is shown. The results are in good agreement at each modulation level with the prediction that isotope production should go as Q varies as $M^{-.82}$, where M is the geomagnetic field strength given as multiples of the current value. The inventories of these isotopes can be obtained by averaging out the fluctuations produced in the production rate by variations in the solar activity level and the geomagnetic field intensity. This yields 3.5 MCi of Be^{10} and 7.7 MCi of Be^{7}. 1 figure. (RWR)

35667 (FERMILAB-CONF—80/40-EXP) **DUMAND data acquisition with triggering.** Brenner, A.E.; Theriot, D.; March, R.H. (Fermi National Accelerator Lab., Batavia, IL (USA); Wisconsin Univ., Madison (USA). Dept. of Physics). 31 Mar 1980. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01.

A data acquisition scheme for the standard DUMAND array that includes a simple triggering scheme as a fundamental part of the system is presented. Although there are a number of not yet fully understood parameters, it is assumed that thresholds can be set in such a manner as to give rise to a triggered signal that is not so dominated by randoms that it gives a substantial decrease in the data acquisition rate over that which would be required by a nontriggered system. It is also assumed that the triggering logic is relatively simple and does not need major computational capabilities for a trigger logic decision. With these assumptions, it is possible to generate the trigger at the array and restrict the data transfer to shore. However, with a not unreasonable delay of 200 microseconds, it is even possible to transmit the information for the trigger to shore and perform all that logic on the shore. The critical point is to send the minimum amount of information necessary to construct the trigger such that one need not send all the possible information in all detectors of the array continuously to shore. 1 figure. (RWR)

STARS

35668 (PPPL—1704) **Toroidal plasma equilibrium with gravity.** Yoshikawa, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 22p. NTIS, PC A02/MF A01.

Toroidal magnetic field configuration in a gravitational field is calculated both from a simple force-balance and from the calculation using magnetic surfaces. The configuration is found which is positionally stable in a star. The vibrational frequency near the equilibrium point is proportional to the hydrostatic frequency of a star multiplied by the ratio (W/sub B//W/sub M/)/sup 1/2/ where W/sub B/ is the magnetic field energy density, and W/sub M/ is the material pressure at the equilibrium point. It is proposed that this frequency may account for the observed solar spot cycles.

35669 **Formation of solar-type stars in spherical symmetry. II. Effects of detailed constitutive relations.** Winkler, K.A.; Newman, M.J. (Max-Planck-Institut fuer Physik and Astrophysik). *Astrophys. J.;* **238**: No. 1, 311-325(15 May 1980).

A time-dependent hydrodynamical calculation of the spherically symmetric self-gravitational collapse and accretion of a homogeneous Jeans unstable 1 M/sub sun/ protostellar cloud has been performed using the detailed equation-of-state tables of Fontaine, Graboske, and Van Horn. It is found that the inner 0.03 M/sub sun/ of the core enters a partially degenerate region during the main accretion phase. A well-pronounced off-center temperature maximum develops under the combined influences of electron degeneracy and pressure ionization. A hydrogen ionization zone within the quasi-hydrostatic core drives core oscillations with typical periods of a few months in the transition phase from the second (final) collpase to the accretion stage. A third collapse does not occur, because of the gradual ("soft") ionization of hydrogen at high density (rho≈1 g cm^{-3}). Gas opacities were taken from the King IVa tables of Cox and Tabor, and dust opacities from Bertout and Yorke. Energy transport by radiation was treated by solution of the time-dependent moment equations with an Eddington factor f derived from the static transport equation. The diffusion approximation with f=1/3 would offer an adequate description of the protostellar core, but the intensity of the constant luminosity radiation field becomes highly anisotropic in local optically thin regions of the envelope. The degree of anisotropy in optically thick regions is determined by the temperature dependence of the dust opacity and the depletion of matter from the envelope. Near the end of the accretion phase the entire envelope is characterized by complete anisotropy f=1.

35670 **Convective and semiconvective mixing in massive stars.** Cloutman, L.D.; Whitaker, R.W. (University of California, Los Alamos Scientific Laboratory). *Astrophys. J.;* **237**: No. 3, 900-902(1 May 1980).

The evolutionary sequence of a 15.57 M/sub sun/ star made with a simplified turbulence transport model demonstrates the importance of accurately modeling the turbulent convection in the stellar interior. The combination of the self-diffusion of turbulence and its finite decay time in a stable region extend the convective core by about 3 M/sub sun/, profoundly affecting the evolution of the star. Among the imporant effects are the elimination of semiconvection and the increase in both the lifetime and luminosity in the hydrogen-burning phase.

35671 **Effects of equation of state on the outcome of stellar collapse.** Lichtenstadt, I.; Sack, N.; Bludman, S.A. (The Hebrew University of Jerusalem). *Astrophys. J.;* **237**: No. 3, 903-911(1 May 1980).

We consider the adiabatic hydrodynamics of a collapsing stellar core, neglecting neutrino losses, so that hydrodynamic shocks are the only mechanism for entropy generation and possible mass ejection. Two qualitatively different mechanisms for the reflected shock mass ejection are distinguished, depending on the thermal stiffness of the outer core and the strength of the reflected shock. (1) For reasonable values of the thermal stiffness of the outer core, shock heating can produce thermal pressure sufficient for mass ejection. The shock heating mechanism operates independently of the inner core equation of state, provided it is stiff enough to arrest infall. (2) Only if the thermal stiffness of the outer core is insufficient does mass ejection require a large pressure deficit and an inner core soft enough to be deeply compressed, violently rebound and oscillate. This bounce shock mechanism is possible only within a narrow range of inner core parameters and leads to neutron stars of practically maximum mass.

GALAXIES

35672 (LA-UR—80-2357) **Search for faint galactic features.** Matuska, W.; Burkhead, M.S. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 16p. (CONF-800853—1). NTIS, PC A02/MF A01.

From Conference on applications of digital image processing to astronomy; Pasadena, CA, USA (20 Aug 1980).

Trying to determine the size of galaxies and looking for tails and connections between galaxies can be intriguing. These very faint features are often buried in the film grain noise. Our study is of the NGC 3623, NGC 3627 and NGC 3628 region. The search for these faint features is complicated by film variation, sky background, microdensitometer drift and stars in the neighborhood of the galaxies. These questions are addressed and faint features are found with the use of judicious data stretching and averaging along suspected features.

COSMOLOGY

REFER ALSO TO CITATION(S) 35722

35673 (LA-UR—78-2925) **Interstellar colonization and the zoo hypothesis.** Jones, E.M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 5p. NTIS, PC A02/MF A01.

Michael Hart and others have pointed out that current estimates of the number of technological civilizations arisen in the Galaxy since its formation is in fundamental conflict with the expectation that such a civilization could colonize and utilize the entire Galaxy in 10 to 20 million years. This dilemma can be called Hart's paradox. Resolution of the paradox requires that one or more of the following are true: we are the Galaxy's first technical civilization; interstellar travel is immensely impractical or simply impossible; technological civilizations are very short-lived; or we inhabit a wildnerness preserve. The latter is the zoo hypothesis. (GHT)

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

35674 (ORO—3861-35) **Vacuum ultraviolet electronic properties of liquids. Progress report.** Painter, L.R. (Tennessee Univ., Knoxville (USA). Dept. of Physics). Jun 1980. Contract AS05-76EV03861. 27p. NTIS, PC A03/MF A01.

A program to study the electronic structure of liquids over the energy range from 2 to 25 eV was carried out from November, 1968 to October 1980. These studies basically consisted of measuring the reflectance, transmittance, photoionization, and photoemission of liquids in the vacuum ultraviolet spectral region as a function of angle of incidence and photon energy. Such measurements are analyzed to yield the optical and dielectric functions of the liquid as functions of photon energy. A summary of the progress in the program is presented. (GHT)

BEAMS AND THEIR REACTIONS

35675 (CONF-800859—3) **Coherent absorption and emission processes of energetic particles penetrating crystals.** Datz, S. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01.

From International conference on x-ray processes and inner-shell ionization; Stirling, UK (25 Aug 1980).

Swift charged particles moving through an ordered array of atoms in a crystal experience periodic perturbations which can give rise to coherent absorption or emission of photons. Indeed the phenomenon of coherent bremsstrahlung arising from ultrarelativistic electron penetration of crystals has been studied for many years. The complexity of the Fourier components of the electric field experienced by the particle is greatly reduced if the direction of motion lies along a crystal axis or in a crystal plane. Here, however, the motion of the particle may be governed by correlated collisions with the atomic rows or planes and the particle is said to be channeled. In this case another periodicity is involved in the motion and transitions between bound states in the transverse motion can lead to radiation of another type which has been dubbed channeling radiation. Channeled, highly stripped ions of sufficiently high atomic number $Z_1 \geq 5$ can exist in a crystal in well defined quantum states and transitions between quantum states can be affected when resonant frequencies, dependent on crystal direction and velocity, are achieved. Studies of resonant coherent excitation of channeled ions constitute a form of absorption spectroscopy which yields information on the ionic states and the crystalline millieu. Experimental observation of both the absorption and emission phenomena in channeling has occurred only in the past two years and a brief review and collation of the various effects observed are presented in this paper.

35676 (CONF-800922—3) **Measurement of properties of perfluorocarbon/SF_6 mixtures relevant to applications.** Pai, R.Y.; Christophorou, L.G.; Sauers, I.; Fatheddin, A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From 6. international conference on gas discharges and their applications; Edinburgh, UK (8 Sep 1980).

It has been found that the addition of 2-C_4F_8 to pure SF_6 or SF_6/N_2 mixtures has a pronounced effect on the non-uniform field breakdown. This effect can be attributed to increased positive and negative ion production which leads to enhanced space charge effects. If this interpretation is correct, addition of 2-C_4F_8 or other perfluorocarbons with large electron attachment rates and low ionization onsets can be used in SF_6 and SF_6/N_2 mixtures to modify the space charge behavior of the gas. The formation of carbon as a breakdown product in perfluorocarbon containing dielectric gas mixtures can be suppressed or eliminated by introduction of components such as SF_6 [or presumably other oxidizer(s)] to react with the discharge products. Mixtures can be formulated with greatly improved dielectric strengths over that of SF_6 without the disadvantage of carbon formation upon sparking. These investigations of the non-uniform field breakdown and carbon inhibition under sparking of 2-C_4F_8 mixtures show that mixtures with superior dielectric strengths (e.g., 20% 2-C_4F_8/80% SF_6) under non-uniform field conditions and little or no carbon formation upon sparking are now available. Optimization of these properties is being pursued.

35677 (LBL—11276) **Photoemission from solids: the transition from solid-state to atomic physics.** Shirley, D.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 13p. (CONF-800859—2). NTIS, PC A02/MF A01.

From International conference on x-ray processes and inner-shell ionization; Stirling, UK (25 Aug 1980).

As the photon energy is increased, photoemission from solids undergoes a slow transition from solid-state to atomic behavior. However, throughout the energy range $h\nu = 10$ to 1000 eV or higher both types of phenomena are present. Thus angle-resolved photoemission can only be understood quantitatively if each experimenter recognizes the presence of band-structure, photoelectron diffraction, and photoelectron asymmetry effects. The quest for this understanding will build some interesting bridges between solid-state and atomic physics and should also yield important new insights about the phenomena associated with photoemission.

35678 **Study of low-current-density microsecond electron beam diodes.** Ramirez, J.J.; Cook, D.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *J. Appl. Phys.;* **51**: No. 9, 4602-4611(Sep 1980).

The performance of several electron sources has been investigated and compared for generating low-current-density microsecond electron beams with applications to gas laser excitation. A brush cathode made with 10-μm-diam carbon filaments gave the best peformance among the various field emitters tested. It emitted well at fields as low as 10 kV/cm. Space-charge-limited flow was established in ~60 ns and apparent gap closure velocities of 1.5 cm/μs were characteristic of this cathode. Two regimes of plasma injected diodes were investigated. First, substantial control of the diode impedence was obtained when the plasma was allowed to fill the entire anode-cathode volume prior to application of the high-voltage pulse; however the anode current density was found to be nonuniform with poor reproducibility from shot to shot. Second, more predictable behavior was obtained when the plasma was constrained to be on the cathode surface at the time the high-voltage pulse was applied. In this case the time integrated anode current density was found to be uniform within +- 15%. Apparent gap closure velocities as low as 2 cm/μs were measured. A description of the high-voltage pulser and of the various plasma sources used for this experiment are also presented.

35679 **Power transmission characteristics of a two-stage multiaperture neutral beam source.** Menon, M.M.; Tsai, C.C.; Schechter, D.E.; Ryan, P.M.; Barber, G.C.; Davis, R.C.; Gardner, W.L.; Kim, J.; Haselton, H.H.; Ponte, N.S.; Whealton, J.H.; Wright, R.E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee). W-7405-ENG-26. *Rev. Sci. Instrum.;* **51**: No. 9, 1163-1167(Sep 1980).

Beam power transmission and grid loading characteristics of a two-stage neutral beam source are presented. The dependence of power deposition on the target, the grids, and the gas cell was studied over a wide range of extraction perveance values with the accel-to-extraction gap field ratio as the other parameter. The results show that the power transmission improves remarkably with increasing field ratio. For sufficiently large field ratios (≥2.5), more than 80% of the input IV power was collected on a target located 4 m downstream and subtending 2 ° half angle to the source. The sum of the grid loading is approximately double that of single-stage accelerators; the plasma grid loading is the highest, followed by ground grid, accel grid, and extraction grid in that order.

35680 **grad B focusing and deposition of relativistic electron beams.** Halbleib, J.A. Sr.; Wright, T.P.; Goldstein, S.A. (Sandia Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76DP00789. *Phys. Rev. Lett.;* **45**: No. 5, 344-346(4 Aug 1980).

delB transport, bunching, and focusing of relativistic electron beams give power deposition levels which may provide the absorbed fluxes of 100 TW/cm² believed necessary to drive breakeven inertial-confinement-fusion targets. Predicted depositions in excess of 100 (TW/g)/MA are presented here. These levels are up to two orders of magnitude higher than those previously calculated and appear to meet the absorbed-flux requirement.

ATOMIC AND MOLECULAR PROPERTIES

35681 (LA—8251-MS) **Atlas of uranium emission intensities in a hollow cathode discharge.** Palmer, B.A.; Keller, R.A.; Engleman, R. Jr. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 242p. NTIS, PC A11/MF A01.

The uranium emission spectrum from a hollow cathode discharge is displayed from 11,000 to 26,000 cm^{-1}. This atlas lists 4928 spectral lines of uranium; 3949 are classified to the neutral spectrum and 431 are classified to the singly ionized spectrum. Listed wavenumbers are accurate to +-0.003 cm^{-1} and the listed relative intensities to +-8%. The richness of the spectrum makes this atlas useful for wavenumber calibration of lasers, spectrographs, and monochromators to an accuracy of 1 part in 10^5. This atlas is also useful as a guide to the uranium spectrum, and relative oscillator strengths (gf values) can be calculated from the intensities to a precision of +-20%.

35682 **Accessibility of the KrF*(B) state to laser photons.** Jacob, J.H.; Trainor, D.W.; Rokni, M.; Hsia, J.C. (AVCO Everett Research Laboratory, Inc., Everett, Massachusetts 02149). DE-AC08-79DP40103. *Appl. Phys. Lett.;* **37**: No. 6, 522-524(15 Sep 1980).

Using electron beam excitation of Ar/Kr/F_2 mixtures in a 1-m laser, we monitored KrF*(B) sidelight fluorescence of the 249-nm B→X transition. Comparing signals observed in the presence and absence of cavity flux, we evaluated the ability of the photon field to depopulate the upper laser level by stimulated emission. From these

experiments, we concluded that some of the KrF* population was in higher vibrational levels and could not be effectively extracted by stimulated emission at the normal laser operating wavelength.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

35683 (COO—2875-13) **Nuclear parameters from muonic and pionic x rays.** Steffen, R.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract AS02-76ER02875. 12p. (CONF-800766—1). NTIS, PC A02/MF A01.

From 5. international conference on hyperfine interactions; Berlin, F.R. Germany (21 Jul 1980).

In view of the higher precision of the experimental data in measurements of the energies and relative intensities of the muonic and pionic x-ray transitions, the validity of the approximations made in extracting nuclear spectroscopic values from the raw data must be scrutinized more carefully if the reliability of the extracted parameters are to approach the accuracy of the experimental data. (GHT)

COLLISION PHENOMENA

35684 (CONF-800859—1) **Multiple ionization and excitation processes in single ion-atom collisions.** Elston, S.B. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

From International conference on x-ray processes and inner-shell ionization; Stirling, UK (25 Aug 1980).

Several experimental methods are discussed, which, by relying on intentionally imposed restrictions such as coincidence requirements and/or special detection geometries, permit measurements differential in several important collision parameters. Such multiply differential measurements are necessary for the isolation of particular excitation and ionization mechanisms and provide much more stringent tests of existing theories. Emphasis is on single collision phenomena involving primarily heavy ions at velocities comparable to K-shell velocities. (GHT)

35685 (LBL—9501(Vol.2)) **Algorithms and computer codes for atomic and molecular quantum scattering theory.** Thomas, L. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 164p. (CONF-790696—(Vol.2)). NTIS, PC A08/MF A01.

From Algorithms and computer codes for atomic and molecular quantum scattering theory conference; Argonne, IL, USA (25 Jun 1979).

This workshop has succeeded in bringing up 11 different coupled equation codes on the NRCC computer, testing them against a set of 24 different test problems and making them available to the user community. These codes span a wide variety of methodologies, and factors of up to 300 were observed in the spread of computer times on specific problems. A very effective method was devised for examining the performance of the individual codes in the different regions of the integration range. Many of the strengths and weaknesses of the codes have been identified. Based on these observations, a hybrid code has been developed which is significantly superior to any single code tested. Thus, not only have the original goals been fully met, the workshop has resulted directly in an advancement of the field. All of the computer programs except VIVS are available upon request from the NRCC. Since an improved version of VIVS is contained in the hybrid program, VIVAS, it was not made available for distribution. The individual program LOGD is, however, available. In addition, programs which compute the potential energy matrices of the test problems are also available. The software library names for Tests 1, 2 and 4 are HEH2, LICO, and EN2, respectively.

35686 (MLM—2760(OP)) **Velocity dependence of low-energy neon-argon total cross sections.** Taylor, W.L.; York, R.W.; Pickett, P.T. (Monsanto Research Corp., Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 22p. (CONF-800715—3). NTIS, PC A02/MF A01.

From 12. international symposium on rarefied gas dynamics; Charlottesville, VA, USA (7 Jul 1980).

A supersonic neon beam passed through a target cell containing argon as the scattering gas was used to measure low-energy elastic total cross sections of NE/AR in the velocity range of approximately 4-10(x 10^4) cm/sec. The absolute particle density in the target cell was obtained by a calibrated volumetric flow system, while the primary beam attenuation was measured quadrupole mass spectrometer detector. Primary beam conditions were varied to investigate the effect of dimer formation and operating conditions were selected so that the dimer fraction was <0.005. Appropriate resolution corrections were made to account for small-angle scattering, and the experimental cross-section values were deconovoluted to obtain second-approximation relative velocity cross sections. Five proposed interatomic potentials were used to calculate theoretical total cross sections and thermal diffusion factors for NE/AR which were compared to experimental results. Only the Exponential-6 potential represented both properties in a consistent fashion.

35687 (UCRL—84785) **Wavepacket theory of collisional dissociation in molecules.** Kulander, K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 11p. (CONF-800829—2). NTIS, PC A02/MF A01.

From International conference on the few body problems; Eugene, OR, USA (17 Aug 1980).

An explicit integration scheme is used to solve the time dependent Schroedinger equation for wavepackets which model collisions in the collinear $H + H_2$ system. A realistic LEPS-type potential energy surface is used. Collision energies considered are above the dissociation threshold and probabilities for collision induced dissociation are reported. Also quantum mechanical state-to-state transition probabilities are generated. These results are compared to extensive classical trajectory calculations performed on this same system. The time evolution of the wavepacket densities is studied to understand the dynamics of the collinear collisional dissociation process.

35688 **Cross sections for the vibrational excitation of the $H_2(X^1\Sigma^+/sub\ g/)$ state via electron collisional excitation of the higher singlet states.** Hiskes, J.R. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *J. Appl. Phys.;* **51**: No. 9, 4592-4594(Sep 1980).

The cross sections are reported for the collisional excitation of the ground state of hydrogen, $H_2X^1\Sigma^+/sub\ g/\ (v''=0)$, leading to vibrational excitation of all fourteen v'' levels. These cross sections pertain to energetic electron collisions populating the $B^1\Sigma^+/sub\ u/$ and $C^1X^{+-}/sub\ u/$ electronic states which in turn radiate to the $X^1\Sigma^+/sub\ g/(v'')$ levels. The cross sections are in the range 10^{-18}—10^{-17} cm². An estimate is made of contributions from higher states.

ATOMIC AND MOLECULAR THEORY

REFER ALSO TO CITATION(S) 35849

35689 (LA-UR—80-2433) **Relativistic effects in the atomic and nuclear few-body problems.** Friar, J.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 14p. (CONF-800829—3). NTIS, PC A02/MF A01.

From International conference on the few body problems; Eugene, OR, USA (17 Aug 1980).

Relativistic effects in the atomic and nuclear few-body systems are classified and discussed with the emphasis on electromagnetic transitions. The size of relativistic corrections, calculational techniques and ambiguities, and comparison of theory and experiment are considered. 8 figures.

FLUID PHYSICS

GENERAL FLUID DYNAMICS

35690 **Gravitational flows of granular materials with incompressible grains.** Nunziato, J.W.; Passman, S.L.; Thomas, J.P. Jr. (Sandia Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *J. Rheol.;* **24**: No. 4, 395-449(Aug 1980).

A theory of flowing granular materials with incompressible grains is presented which is similar to one proposed by Goodman and Cowin in 1972. Using a nonlinear version of the theory, boundary-value problems corresponding to gravity flow in a closed vertical channel and in a channel with a free surface inclined at various angles from the vertical are considered in detail. In analyzing these problems, the dependence of the free energy and viscosity on the volume fraction are specialized to agree with those proposed as a result of recent experimental work. Solutions of these problems demonstrate many of the characteristics normally assumed in other treatments of granular materials. In particular, for vertical flow, when the volume fraction is greater than (less than) the critical volume fraction, a compressive (tensile) force must be exerted on the walls to maintain isochoric flow. Pluglike regions in which the velocity is almost constant develop, and there is a relative thin shear region near the wall. For the flow with a free surface, as grain size or angle of inclination increases, the solutions tend to two rigid motions separated by a thin shear layer.

PROPERTIES AND STRUCTURE OF FLUIDS

35691 **Electro-optical surface flashover measurements.** Thompson, J.E.; Lin, J.; Mikkelson, K.; Kristiansen, M. (College of Engineering, University of South Carolina, Columbia, South Carolina 29208). *Appl. Phys. Lett.;* **37**: No. 6, 574-576(15 Sep 1980).

Electro-optical measurements of the electric field along solid insulator/vacuum interfaces have been made to determine the mechanisms associated with fast (ns) insulator flashover. Data showing the temporal and spatial performance of the insulator surface fields

prior to and at flashover are presented. The results show that the intergap electric field is modified in a manner consistent with positive surface charging by field emitted electrons. The data also show that the enhanced intergap fields are reduced prior to flashover. Mechanisms consistent with this behavior are postulated.

SUPERFLUIDITY

35692 (DOE/ER/01198—1320) **Steady-state and second measurements of Kapitza resistance.** Katerberg, J.A. (Illinois Univ., Urbana (USA)). 1980. Contract AC02-76ER01198. 120p. NTIS, PC A06/MF A01.

Thesis.

Published steady-state (dc) and second-sound (ac) measurements of the Kapitza resistance (R/sub K/) have differed in reports of the temperature dependence of R/sub K/. The two types of measurements were also seen to conflict on the measured effects of sample damage on the magnitude of R/sub K/. To resolve these differences, measurements of R/sub K/ have been made using both techniques on the same sample, during the same experimental run. Our measurements, made on copper-liquid helium interfaces from 1.1 to 2.1 K, show excellent agreement between the dc and ac results. No evidence is seen for a frequency-dependent Kapitza resistance. Our measurements show an increase in R/sub K/ when the sample is damaged, agreeing with published ac measurements, but disagreeing with published dc measurements. The temperature dependence of R/sub K/ in our measurements is approximately T^{-3} from 1.5 to 2.1 K, in agreement with published dc measurements. A T^{-4} dependence has been seen in the published ac experiments. In our experiments, a T^{-4} dependence is observed only when second sound is coupled from the generating cavity to the helium bath.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

35693 (BNL—28178) **Anomalous low mass e^+e^- pair production in 17 GeV/c π^-p collisions.** Abshire, G.; Adams, M.; Brown, C. (Brookhaven National Lab., Upton, NY (USA); Pennsylvania Univ., Philadelphia (USA); State Univ. of New York, Stony Brook (USA)). 1980. Contract AC02-76CH00016. 41p. (CONF-800724—23). NTIS, PC A03/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

An experiment was performed at the Multiparticle Spectrometer using 17 GeV/c π^- from the BNL AGS, triggering upon inclusive e^+e^- production. Electron identification was based on two transition radiator detectors and lead-scintillator shower detectors. Good acceptance for the e^+e^- pair covered the region x/sub F/ > 0.3 for all p/sub T/ and pair masses. Charged particles and photons associated with the e^+e^- pair are detected over a large solid angle. e^+e^- pairs of mass up to 1.2 GeV/c^2 were produced. A clear peak due to rho, $\omega \rightarrow e^+e^-$ is observed. For e^+e^- masses below the rho, ω, an excess of events is found over those expected from known sources such as eta $\rightarrow e^+e^-\gamma$ and $\omega \rightarrow e^+e^-\pi^0$. This anomalous excess is more strongly produced at small x/sub F/. The structure of events containing anomalous e^+e^- pairs is reported in an attempt to elucidate their origin. In particular, effective mass distributions of $e^+e^-\gamma$, $e^+e^-\pi^0$, e^+e^- charged hadrons are presented.

35694 (DOE/ER/02232—89) **Diffractive hadron dissociation at 100 and 200 GeV.** Cool, R.L.; Goulianos, K.; Segler, S.L.; Sticker, H.; White, S.N. (Rockefeller Univ., New York (USA)). 1980. Contract AC02-76ER02232. 15p. (CONF-800724—18). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

The M^2/sub x/ and t dependence of the reaction h + p → X + p (h = π/sup +-/, K/sup +-/, p/sup +-/) were measured at incident momenta of 100 and 200 GeV/c in the kinematic region 0.025 < parallel t parallel < 0.095 (GeV/c)^2 and M^2/sub x//s < 0.1. The differential cross sections are exponential in t, vary predominantly as $1/m^2$/sub x/, and agree well with factorization rules. The data were used in combination with elastic scattering data obtained in the same experiment to test the Finite Mass Sum Rule.

35695 (DOE/ER/02232—91) **Measurement of the transverse momenta of partons, and of jet fragmentation as a function of $\sqrt{s}$ in p-p collisions.** Angelis, A.L.S.; Besch, H.J.; Blumenfeld, B.J. (European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York (USA); Oxford Univ. (UK); Rockefeller Univ., New York (USA)). 1980. Contract AC02-76ER02232. 13p. (CONF-800724—19). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A large solid angle apparatus consisting of a superconducting solenoid magnet, cylindrical drift chambers and two arrays of lead-glass counters was used to examine particles associated with a high transverse momentum trigger in p-p collisions with three $\sqrt{s}$ values at the CERN ISR. The trigger was given by energy deposition in lead-glass arrays centered at 90°. The trigger transverse momentum range covered was 3 < P/sub Ttrig/ < 11 GeV/c. Results are given for P/sub out/ for both individual charged particles, and also for the sum of charged particle momenta in the hemisphere opposite to the trigger. Mean vaues are then deduced for the parton transverse momentum, k/sub T/, and for the jet fragmentation momentum, j/sub T/.

35696 (FERMILAB-CONF—79/85-EXP) **Search for direct photon production at Fermilab energies and comparison with direct photon measurements at ISR energies.** Cox, B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1979. Contract AC02-76CH03000. 9p. (CONF-790885—20). NTIS, PC A05/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

A search for direct photon production has been performed at Fermilab in 200 and 300 GeV/c proton-Be interactions over a wide range of X/sub F/ and P/sub perpendicular to/. An excess of photons has been detected which when interpreted as single photon production yields a γ/π^0 ratio which averages .070 +- .025 in the region 1.5 < p/sub perpendicular to/ < 4.0 GeV/c and -.7 < X/sub F/ < .0. This measurement is discussed and a comparison of this result with the ISR measurements of the γ/π^0 ratio has been made in an attempt to infer the energy dependence of direct photon production.

35697 (LBL—11322) **Jets in e^+e^- annihilation.** Cooper, S.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 157p. NTIS, PC A08/MF A01.

Thesis.

The properties of jets produced in e^+e^- annihilation have been investigated using data taken with the Mark I detector at SPEAR. The momentum distributions parallel and perpendicular to the jet axis were measured for all charged tracks, for K^0's, and for rho^0's. The K^0 and rho^0 Pt^2 distributions are well fit by the form $dn/dPt^2 = A \exp(-B^* Pt^2)$ with B = 4.6 +/- 0.2 for K^0's and 5 +/- 1 for rho^0's. The charged particle Pt^2 distribution cannot be fit with a single exponential, but is similar to that of K^0's and rho^0's above $Pt^2 \sim 0.2$ GeV^2. The charged particle and K^0 parallel momentum distributions are similar in shape and approximately exponential. The production of rho^0's at low parallel momentum is suppressed. The average number of rho^0's per event is 0.4 +/- 0.1. 59 figures, 7 tables.

35698 (ORO—3992-383) **What can we learn from high-energy hadron-nucleus interactions.** Tow, D.M. (Texas Univ., Austin (USA). Center for Particle Theory). Dec 1979. Contract AS05-76ER03992. 41p. (CONF-800120—5). NTIS, PC A03/MF A01.

From Conference on theoretical particle physics; Guangchou, China (5 Jan 1980).

High-energy hadron-nucleus (hA) collisions provide the exciting possibility of giving information about the spacetime development of hadron-hadron interactions and therefore differentiating various multiparticle production models. Some of the major developments in this field during the past decade, both experimentally and theoretically are reviewed. Several general features of the data are pointed out, and several classes of models are discussed. A recently proposed simple spacetime model for high-energy hA collisions is elaborated. Comments are made on the extension to nucleus-nucleus interactions and the future outlook.

35699 **Observation of a fourth upsilon state in e^+e^- annihilations.** Andrews, D.; Berkelman, K.; Cabenda, R.; Cassel, D.G.; DeWire, J.W.; Ehrlich, R.; Ferguson, T.; Gentile, T.; Gilchriese, M.G.D.; Gittelman, B.; Hartill, D.L.; Herrup, D.; Herzlinger, M.; Kreinick, D.L.; Mistry, N.B.; Nordberg, E.; Perchonok, R.; Plunkett, R.; Shinsky, K.A.; Siemann, R.H.; Silverman, A.; Stein, P.C.; Stone, S.; Talman, R.; Thonemann, H.G.; Weber, D.; Bebek, C.; Haggerty, J.; Izen, J.M.; Loomis, W.A.; Pipkin, F.M.; Rohlf, J.; Tanenbaum, W.; Wilson, R.; Sadoff, A.J.; Bridges, D.L.; Chadwick, K.; Ganci, P.; Kagan, H.; Kass, R.; Lobkowicz, F.; Melissinos, A.; Olsen, S.L.; Poling, R.; Rosenfeld, C.; Rucinski, G.; Thorndike, E.H.; Warren, G.; Bechis, D.; Mueller, J.J.; Potter, D.; Sannes, F.; Skubic, P.; Stone, R.; Brody, A.; Chen, A.; Goldberg, M.; Horwitz, N.; Kandaswamy, J.; Kooy, H.; Lariccia, P.; Moneti, G.C.; Alam, M.S.; Csorna, S.E.; Panvini, R.S.; Poucher, J.S. (Cornell University, Ithaca, New York 14853). *Phys. Rev. Lett.;* **45**: No. 4, 219-221(28 Jul 1980).

A fourth state in the upsilon energy region has been seen in e^+e^- collisions at the Cornell Electron Storage Ring. A resonance is observed with a mass 1112 +- 5 MeV above the lowest upsilon state. The 9.6-MeV rms width is greater than the 4.6-MeV energy resolution of the e^+e^- beams. The observed characteristics of the new state make it a likely candidate for the 4^3S state of the bb-bar system, lying above the threshold for the production of B mesons.

35700 Observation of the Y'''' at the Cornell electron-storage ring. Finocchiaro, G.; Giannini, G.; Lee-Franzini, J.; Schamberger, R.D. Jr.; Sivertz, M.; Spencer, L.J.; Tuts, P.M.; Boehringer, T.; Costantini, F.; Dobbins, J.; Franzini, P.; Han, K.; Herb, S.W.; Kaplan, D.M.; Lederman, L.M.; Mageras, G.; Peterson, D.; Rice, E.; Yoh, J.K.; Levman, G. (State University of New York at Stony Brook, Stony Brook, New York 11794). *Phys. Rev. Lett.;* **45**: No. 4, 222-225(28 Jul 1980).

During an energy scan at the Cornell Electron Storage Ring, with use of the Columbia University-Stony Brook NaI detector, an enhancement in $\sigma(e^+e^-\rightarrow$hadrons) is observed at center-of-mass energy ~10.55 GeV. The mass and leptonic width of this state (Y'''') suggest that it is the 4 $^3S_1$ bound state of the b quark and its anitquark. After applying to the data a cut in a (pseudo) thrust variable, the natural width is measured to be $\Gamma=12.6 +- 6.0$ MeV, indicating that the Y'''' is above the threshold for BB-bar production.

35701 Direct measurement of the negative-kaon form factor. Dally, E.B.; Hauptman, J.M.; Kubic, J.; Stork, D.H.; Watson, A.B.; Guzik, Z.; Nigmanov, T.S.; Riabtsov, V.D.; Tsyganov, E.N.; Vodopianov, A.S.; Beretvas, A.; Grigorian, A.; Tompkins, J.C.; Toohig, T.E.; Wehmann, A.A.; Poirier, J.A.; Rey, C.A.; Volk, J.T.; Rapp, P.D.; Shepard, P.F. (Physics Department, University of California, Los Angeles, California 90024). *Phys. Rev. Lett.;* **45**: No. 4, 232-235(28 Jul 1980).

The electromagnetic form factor of the negative kaon has been measured by direct scattering of 250 GeV/c kaons from the stationary electrons of a liquid-hydrogen target. The deviation of the measured elastic scattering cross section from the point cross section may be characterized by a root-mean-square kaon radius of <r^2/sub K/->/sup 1/2/=0.53 +- 0.05 fm.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 35351

35702 (COO—1195-452) **Diffractive hadronic production of D mesons.** MacKay, W.W. (Illinois Univ., Urbana (USA). Dept. of Physics). 1980. Contract AC02-76ER01195. 116p. NTIS, PC A06/MF A01.

Thesis.

This thesis reports on data taken in experiment E369 using the Chicago Cyclotron Spectrometer at Fermilab. A search for charmed D mesons was made using a beam of 217 GeV π^- incident on a liquid hydrogen target. The trigger required a recoil proton and a prompt muon. A total of 50 +- 12 charged D events were seen in the $K^{+-}\pi^{+-}\pi^{+-}$ channels and were split between the two channels in about equal amounts. Cuts were made which selected diffractive events, but when these cuts were removed the signal remained the same although the background was greatly increased. The Feynman x and angular distributions were consistent with diffractive production. A diffractive model yields a cross section of (6 to 10) + 4 μb.

35703 (FERMILAB-CONF—79/79-EXP) **Recent experimental measurements of the neutrino charged current cross sections.** Theriot, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1979. Contract AC02-76CH03000. 7p. (CONF-790885—18). NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

Recent experimental measurements of the neutrino charged current total cross sections are reviewed. (GHT)

35704 (FERMILAB-CONF—79/80-EXP) **Review of recent measurements of charmed particle lifetimes using emulsions.** Voyvodic, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1979. Contract AC02-76CH03000. 7p. (CONF-790885—19). NTIS, PC A02/MF A01.

From 9. international symposium on lepton and photon interactions at high energy; Batavia, IL, USA (23 Aug 1979).

This talk is a review of results which have been reported during the past year on charmed particle decays in emulsions.

35705 Inclusive production of nonstrange resonances in high-energy νp charged-current interactions. Berge, J.P.; Bogert, D.V.; Endorf, R.J.; Hanft, R.; Malko, J.A.; Nezrick, F.A.; Lynch, G.R.; Marriner, J.P.; Stevenson, M.L.; Cence, R.J.; Harris, F.A.; Jones, M.; Peters, M.W.; Peterson, V.Z.; Stenger, V.J.; Wyatt, N.; Bell, J.; Coffin, C.T.; Diamond, R.N.; Louis, W.C.; Roe, o.P.; Ross, R.T.; Seidl, A.A.; Wang, E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **22**: No. 5, 1043-1050(1 Sep 1980).

We have examined the inclusive production of nonstrange particle resonances in νp interactions using the Fermilab 15-ft bubble chamber. A sample of 2437 charged-current events with visible longitudinal momentum greater than 10 GeV/c was obtained. The rho^0 and Δ^{++}(1232) are seen. An overall rate of 0.21 +- 0.04 rho^0 per event is found. For five-prong events, the rate is 0.44 +- 0.08 rho^0 per event. The rho^0 Z distribution falls rapidly for Z greater than 0.4. The production of Δ^{++} is seen clearly in events with an identified proton. No evidence is seen for Δ^0 production. An upper limit of 0.34 is placed on the ratio of eta/π^0 (90% confidence level).

STRONG BARYON-INDUCED INTERACTIONS

35706 Search for baryonium states in the reaction pp→ppp-barp at 11.75 GeV/c. Kooijman, S.; Arenton, M.W.; Ayres, D.S.; Diebold, R.; May, E.N.; Nodulman, L.; Sauer, J.R.; Wicklund, A.B.; Swallow, E.C. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **45**: No. 5, 316-319(4 Aug 1980).

A search was made for five-quark "pseudobaryon" and four-quark baryonium states with a 1000-event sample of the reaction pp→ppp-barp at 11.75 GeV/c. For states with widths < or ≈10 MeV/c^2 and masses M/sub p/p<2.2 Gev/c^2 and M/sub p/pp-bar<3.4 GeV/c^2, upper limits on the product of the cross section and the branching ratio for forward-hemisphere production are measured to be ~15 nb.

STRONG MESON-INDUCED INTERACTIONS

35707 States of /sub Λ/^{12}C formed in the reaction ^{12}C(K$^-$,π^-). Chrien, R.E.; May, M.; Palevsky, H.; Sutter, R. (Brookhaven National Lab., Upton, NY (USA)); Barnes, P.; Dytman, S.; Marlow, D.; Takeutchi, F. Contract EY-76-C-02-0016;DE-AS05-76ER03948. *Phys. Lett., B;* **89**: No. 1, 31-35(31 Dec 1979).

States of /sub Λ/^{12}C formed in the (K$^-$,π^-) reaction have been studied for momentum transfers up to 260 MeV/c, by using an incident K$^-$ beam of 800 MeV/c momentum. The angular distributions for the g.s. and for a peak at 11 MeV have been measured between 0° and 19° in the laboratory. Limits on the splitting of the 11 MeV peak and on the formation of low-lying excited states are given.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

35708 (FERMILAB-CONF—80/75-THY) **Inverse scattering and the Y family.** Quigg, C.; Rosner, J.L. (Fermi National Accelerator Lab., Batavia, IL (USA); Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Aug 1980. Contract AC02-76ER01764;AC02-76CH03000. 6p. (CONF-800724—22). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A quarkonium potential is constructed with the help of masses and leptonic widths of the Y(1S-4S) levels using the inverse scattering formalism. This potential agrees at all interquark separations beyond 0.06 f with one constructed earlier from psi and psi', providing further evidence for flavor independence of the Q anti Q interaction. Comparison with other a priori potentials suggests that tests for a short-range Coulomb interaction (as predicted by QCD) will have to rely primarily on more precise values for $\Gamma(Y\rightarrow e^+e^-)$, on measurement of the 2S-2P spacing (predicted to be about 120 MeV for a short-range Coulomb-like interaction or in the inverse scattering formalism but about 150 MeV for an effective power-law potential), and on the discovery of heavier quarks.

GENERAL

35709 Do quarks interact pairwise and satisfy the color hypothesis?. Stanley, D.P.; Robson, D. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Phys. Rev. Lett.;* **45**: No. 4, 235-238(28 Jul 1980).

A simple three-quark Hamiltonian based on a quark-antiquark interaction which accurately describes all qq-bar mesons has been solved numerically. Good agreement with the ground-state baryon mass spectrum is obtained if the qq and qq-bar interactions differ by an overall factor of 2 as expected from an octet color-exchange mechanism. The interactions in a three-quark system appear to be very well described by only a sum of pair interactions.

ELECTROMAGNETIC INTERACTIONS

35710 (DOE/ER/02232—90) **Study of direct single photons and correlated particles in proton-proton collisions at $\sqrt{s}$ = 62.4 GeV.** Angelis, A.L.S.; Besch, H.J.; Blumenfeld, B.J. (European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., New York (USA); Oxford Univ. (UK); Rockefeller Univ., New York (USA)). 1980. Contract AC02-76ER02232. 21p. (CONF-800724—17). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

As part of a study of large p/sub T/ phenomena in proton-proton collisions at the CERN ISR, a search for direct single photon

production has been performed. A statistical division of the data sample into the fraction consistent with single photon production and the fraction due to multiphoton decays of neutral hadrons is accomplished by measuring the average conversion probability for the sample in a one radiation length thick converter. The fraction of the sample attributable to direct single photon production is $< \gamma/\text{all} > = 0.074 +- 0.012$ for 6 GeV/c < p/sub T/ < 10 GeV/C, and $< \gamma/\text{all} > = 0.26 +- 0.04$ for p/sub T/ > 10 GeV/c, with an additional systematic uncertainty of +- 0.05 for both values. It is found that single photons are produced preferentially with no accompanying particles on the same side. The ratio of positive to negative particles on the away side is found to be 3.7 +- 1.2 at high x/sub E/ and p/sub T/ for the single photon events.

35711 Left-right-symmetric gauge theory consistent with all experiments: A viable alternative to the Weinberg-Salam model. Sidhu, D.P. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **22**: No. 5, 1158-1165(1 Sep 1980).

I discuss a left-right-symmetric model of weak and electromagnetic interactions which is consistent with the results of all weak-interaction experiments including observed parity violation in eN interactions. The model is essentially indistinguishable from the Weinberg-Salam (WS) model at low energies and differs from it significantly at high q^2. Of the two (Z_1,Z_2) neutral bosons of the model, MZ-italic$_1$≅M/sub Z/ of the WS model and MZ-italic$_2$≅2.5M/sub Z/$_1$≅230 GeV. The prospects of distinguishing the two classes of models in e^+e^- experiments at LEP and in pp and p-barp colliding-beam experiments at ISABELLE are also discussed.

35712 Isolating gluon jets. Nilles, H.P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Phys. Rev. Lett.;* **45**: No. 5, 319-322(4 Aug 1980).

It is shown that the identification of gluon and quark jets in the process e^+e^-→three jets is feasible if the gluon is radiated off heavy quarks. Gluon energy spectra are computed for e^+e^-→bb-barg in the 30—40-GeV energy region and for e^+e^-→Z^0→tt-barg.

35713 Evidence for unequal lifetimes of the D^0 and D^+. Bacino, W.; Ferguson, T.; Nodulman, L.; Slater, W.; Ticho, H.; Diamant-Berger, A.; Donaldson, G.; Duro, M.; Hall, A.; Irwin, G.; Kirkby, J.; Merritt, F.; Wojcicki, S.; Burns, R.; Condon, P.; Cowell, P.; Kirz, J. (Physics Department, University of California, Los Angeles, California 90024). DE-AC03-76SF00515. *Phys. Rev. Lett.;* **45**: No. 5, 329-332(4 Aug 1980).

In the reaction e^+e^-→psi''(3770), events containint either one or two electrons have been observed originating in semileptonic decays of D mesons. A comparison of these samples provides a determination of the branching ratios: b(D^0→Xεν)<4.0% (at 95% confidence level) and b(D^+→Xεν)22.0< +4.4>-2.2(per-cent)=. These values imply that the ratio of D^0 and D^+ lifetimes is tau(D^+)/tau(D^0)>4.3 (at 95% confidence level).

35714 Quark magnetic moments and E1 radiative transitions in charmonium. Karl, G.; Meshkov, S.; Rosner, J.L. (Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1, Canada). CY-76-C-02-1764. *Phys. Rev. Lett.;* **45**: No. 4, 215-218(28 Jul 1980).

In the long-wavelength limit, Γ(Psi'→γ+chi/sub J/)=const. x (2J+1)rho/sub γ/ ^{3} and Γ(chi/sub J/→γ+Psi)=const. x rho/sub γ/ ^{3}. The corrections to these expressions of order rho/sub γ//m/sub c/(m/sub c/ is the mass of the charmed quark) are calculated. These corrections are found to be proportional to <LxS>J-italic x κ, where <LxSJ-italic=1, -1, -2 for J=2, 1, 0, and κ is the anomalous magnetic moment of the quark. Angular distributions of photons in the decays Psi'→γchi and chi→γPsi also are predicted; small but probably measurable deviations from the pure E1 limit are found.

35715 CP nonconservation without elementary scalar fields. Eichten, E.; Lane, K.; Preskill, J. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). DE-AC02-76ER01545. *Phys. Rev. Lett.;* **45**: No. 4, 225-228(28 Jul 1980).

Dynamically broken gauge theories of electroweak interactions provide a natural mechanism for generating CP nonconservation. Even if all vacuum angles are unobservable, strong CP nonconservation is not automatically avoided. In the absence of strong CP nonconservation, the neutron electric dipole moment is expected to be of the order 10^{-24} excm.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 35711, 35713, 35715

35716 (SLAC—227) **Strong effects in weak nonleptonic decays.** Wise, M.B. (Stanford Linear Accelerator Center, CA (USA)). Apr 1980. Contract AC03-76SF00515. 65p. NTIS, PC A04/MF A01.

In this report the weak nonleptonic decays of kaons and hyperons are examined with the hope of gaining insight into a recently proposed mechanism for the ΔI = 1/2 rule. The effective Hamiltonian for ΔS = 1 weak nonleptonic decays and that for K^0-anti K^0 mixing are calculated in the six-quark model using the leading logarithmic approximation. These are used to examine the CP violation parameters of the kaon system. It is found that if Penguin-type diagrams make important contributions to K → ππ decay amplitudes then upcoming experiments may be able to distinguish the six-quark model for CP violation from the superweak model. The weak radiative decays of hyperons are discussed with an emphasis on what they can teach us about hyperon nonleptonic decays and the ΔI = 1/2 rule.

35717 Corrections to quantum-chromodynamic Born terms. I. Dilepton production and leptoproduction. Contogouris, A.P.; Marleau, L. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **22**: No. 5, 1102-1108(1 Sep 1980).

Certain corrections of second order in the quantum-chromodynamic coupling α/sub s/ are studied for dilepton production and for leptoproduction. A problem of convention dependence is analyzed, and an explicit solution is presented. In terms of this it is found that at present dilepton masses M the O(α/sub s/ ^{2}) correction to the Drell-Yan formalism due to the subprocess q+q → q+q+γ^* is small, but that it increases with M. Corresponding corrections to leptoproduction are found to be completely negligible, thus justifying the use of the solution.

35718 Energy dependence of semileptonic branching ratio averaged over D mesons. Katuya, M. (Laboratory of Physics, Shizuoka Women's University, Yada 409, Shizuoka 422, Japan). W-7405-ENG-82. *Phys. Rev., D;* **22**: No. 5, 1120-1123(1 Sep 1980).

The energy dependence of the semileptonic branching ratio averaged over the D^0 and D^+ mesons is discussed. It is pointed out that the semileptonic branching ratio averaged over D mesons at √s-bar=4.0—4.2 GeV should be considerably smaller than at √s-bar=3.77 GeV and √s-bar=4.2—4.5 GeV in order to be consistent with the experimental data on the ratios of lifetimes and production cross sections for charged versus neutral D mesons.

35719 Heavy-quark—antiquark potential in the MIT bag model. Haxton, W.C.; Heller, L. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., D;* **22**: No. 5, 1198-1208(1 Sep 1980).

The MIT bag model for a meson composed of a heavy quark and a heavy antiquark is solved using the Born-Oppenheimer approximation. For fixed qq-bar separations the color-electric fields and bag shapes are determined by solving numerically the Yang-Mills equations with bag boundary conditions to lowest order in the quark-gluon coupling constant. Spin effects are not included. The resulting bag energy is used as a potential energy in the Schroedinger equation for the relative motion of the quarks. Good agreement with the experimental psi and Y spectra and leptonic decay widths is found. When the same potential is applied to strange-quark systems, a consistent picture of the masses of the phi and F^* mesons emerges. The relation between spectroscopy and the variation of the coupling constant with distance is explored.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 35735

35720 (BNL—27979) **Complementary aspects of potential and quark models for BB and B anti B systems.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 17p. (CONF-800688—1). NTIS, PC A02/MF A01.

From 5. European symposium on nucleon-antinucleon interactions; Bressanone, Italy (Jun 1980).

Our topic at this Round Table is the connection between the particle physics (quark model) and nuclear physics (potential model) approaches to baryonium. This question is part of a larger problem which arises in a variety of contexts in strong interaction physics: how does one reconcile the success of meson (and baryon) exchange models for many low energy hadron-hadron scattering processes with the structure of the underlying quark model. This general problem is discussed, using as examples: (1) baryon-baryon (BB) and baryon-nucleus (specifically N, Λ, Σ, and XI) interactions; and (2) baryon-antibaryon (B anti B) systems and their coupling to diquark-antidiquark (Q^2 anti Q^2) complexes; and (3) interactions of antinucleons with nuclei.

35721 (SLAC-PUB—2506) **Triple gluon coupling, Adler-Bell-Jackiw anomaly, and polarized deep inelastic scattering.** Lam, C.S.; Li, B.A. (Stanford Linear Accelerator Center, CA (USA)). May 1980. Contract AC03-76SF00515. 46p. (CONF-800724—9). NTIS, PC A03/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

An unusual effect of triple gluon coupling and the Adler-Bell-Jackiw anomaly on the flavor singlet part of the polaried deep inelastic scattering structure function $\nu G_1(Q^2,x)$ are discussed.

Namely, the x-integral I/sub S/(Q^2) of this function is Q^2-independent both in parton model and leading logarithm calculations, but the first order nonleading logarithm calculation produces a term growing like (-lnlnQ^2), dominating over the parton model contributions at large Q^2. The detection of this unusual term will amount to an experimental confirmation of the existence of triple gluon coupling and the Adler-Bell-Jackiw anomaly. Technically, this term comes from a new axial vector gluon operator which is introduced in the Wilson expansion. Other results of this paper include a discussion of mass-sensitive and mass-insensitive structure functions and the derivation of the expression for, and the relations between, some of these structure functions.

35722 Possible production of "collapsed" hadronic matterin very-high-energy nucleon-nucleon collisions. Mann, A.K.; Primakoff, H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). DE-AC02-76-ER0-3071. *Phys. Rev., D;* **22**: No. 5, 1115-1119(1 Sep 1980).

We speculate on the possible production of "collapsed" hadrons, i.e., color-singlet, electrically uncharged (or with small integral charge) clusters of quarks and antiquarks, in very-high-energy proton-proton collisions, the intermediate states of which contain relatively large numbers of quarks q, antiquarks q-bar, and gluons g. Using a thermodynamic model, we crudely estimate the numbers and kinetic energies of the q, q-bar, and g in the intermediate-state gas mixture, and indicate how the properties of collapsed hadrons might depend on the quantum numbers of the q and q-bar. A brief discussion of experimental signatures for identification of collapsed hadrons is presented, along with mention of the consequences of possible collapsed-hadron production in the early Universe.

35723 Heavy Higgs bosons in the Weinberg-Salam model. Longhitano, A.C. (J. W. Gibbs Laboratory, Department of Physics, Yale University, New Haven, Connecticut 06520). EY-76-C-02-3075. *Phys. Rev., D;* **22**: No. 5, 1166-1175(1 Sep 1980).

We search for a systematic way to characterize the low-energy sensitivity of the minimal Weinberg-Salam model to a heavy-Higgs-boson sector. We find that it is convenient to view this theory as the regulated version of a nonlinear σ model coupled to an SU(2)/sub L/ x U(1) Yang-Mills theory. Within this framework, M/sub H/ acts as the regulator. Using the symmetry properties of the nonlinear theory, along with a power-counting analysis, we are able to classify low-energy observables according to their sensitivity to M/sub H/. We find that, at one loop, the greatest sensitivity is logarithmic. An illustration of these ideas is provided by a calculation of the one-loop, M/sub H/-dependent corrections to the natural relation M/sub W//M/sub Z/ $\cos\theta = 1$. Finally, we discuss other possible applications of this technique.

35724 Q^2 evolution of multihadron fragmentation functions. Sukhatme, U.P.; Lassila, K.E. (Ames Laboratory: Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., D;* **22**: No. 5, 1184-1189(1 Sep 1980).

In order to characterize jet structure more completely than is possible with the single-hadron fragmentation functions of partons, we deduce the evolution (in Q^2) equations for the fragmentation functions of a parton to fragment into an arbitrary number N of hadrons. The solution to the evolution equations is explicitly displayed in terms of multiple moments for the N-hadron fragmentation functions. Our procedure is simpler than using the rules of the jet calculus. We also show how the Q^2 dependence of these fragmentation functions can be understood in a recursive cascade-model framework in which both the momentum and the amount by which a parton is off its energy shell (as measured by Q^2) are reduced at each branching step during jet formation. This reformulation suggests an alternative way for solving the evolution equations in which moment inversion is not required.

35725 Space-time structure of jet hadronization. Minakata, H. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **45**: No. 5, 325-328(4 Aug 1980).

The space-time development of jet hadronization is investigated in two-dimensional quantum electrodynamics. It is found that the characteristic space-time scale of jet hadronization is considerably shorter than the one given by approximately free propagation of quarks.

35726 Topological bootstrap prediction of three-"colored," eight-flavored quarks. Chew, G.F.; Poenaru, V. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Phys. Rev. Lett.;* **45**: No. 4, 229-231(28 Jul 1980).

This letter describes a topological bootstrap theory of strong interactions that generates baryon number, three topological "colors" and spin-1/2 confined "quarks" with eight flavors. Extension to electromagnetism allows the topological objects called "quarks" to be associated with leptons, so that eight leptons are predicted.

STRONG INTERACTIONS, BARYON NO.=0

35727 Strong anomaly and eta $\rightarrow 3\pi$ decay. Milton, K.A.; Palmer, W.F.; Pinsky, S.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **22**: No. 5, 1124-1127(1 Sep 1980).

The amplitude for eta $\rightarrow 3\pi$ is calculated in terms of the amplitude for eta' $\rightarrow$ eta$\pi\pi$ using the strong anomaly and the partial conservation of the U(1) current. The isospin violation, an (m/sub u/-m/sub d/)/(m/sub u/+m/sub d/) effect, is large. The eta' decay constant is estimated from psi $\rightarrow$ eta'γ. The result for eta $\rightarrow 3\pi$ is in good agreement with experiment.

STRONG INTERACTIONS, BARYON NO.=1

35728 (BNL—28198) Bag model, the hyperspherical formalism and the heavy baryons. Richard, J.M. (Brookhaven National Lab., Upton, NY (USA); European Organization for Nuclear Research, Geneva (Switzerland)). 1980. Contract AC02-76CH00016. 6p. (CONF-800763—1). NTIS, PC A02/MF A01.

From Baryon 80 conference; Toronto, Canada (14 Jul 1980).

The bag model framework is used to discuss the heavy baryons, triple flavored objects like ccc, cbb, etc. A nonrelativistic picture seems justified. It is insisted that the long-range interaction consist of a genuine three-body force. Once the potential energy of the three quarks is determined, the three-body Schroedinger equation is solved by the method of hyperspherical expansion. 1 table. (RWR)

35729 Interaction of isovector scalar mesons with simple sources. II. Isobars and meson scattering. Bolsterli, M. (T Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG.36. *J. Math. Phys. (N.Y.);* **21**: No. 9, 2455-2460(Sep 1980).

For the case of a static source, appropriate special coherent states are defined so as to give a relatively simple treatment of states of any isospin in the no-meson and one-meson approximations. The analogous localized coherent states for nonstatic sources are described and shown to be suitable for use in translated-localized-state calculations.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

35730 Experimental constraint on widths of postulated low-mass dibaryons. Wainer, J.; Lomon, E.L. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-C-02-3069. *Phys. Rev., D;* **22**: No. 5, 1217-1220(1 Sep 1980).

The consistency of a postulated $^3P_1$ resonance near E/sub L/ = 390 MeV with the experimentally determined nucleon-nucleon phase shifts at E/sub L/ = 325, 380, and 425 MeV is examined. It is found that the data require that the width of such a resonance $\Gamma <$ or $\approx$0.3 MeV. A similar restriction on the width of a postulated $^1S_0$ resonance near E/sub L/ = 300 MeV is implied by the accuracy of the data at E/sub L/ = 210, 325, and 380 MeV.

35731 Angular distributions for the $^{12}C(K^-,\pi^-)$sub $\Lambda/^{12}C$ reaction. Dover, C.B. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA)); Gal, A. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics); Walker, G.E. (Indiana Univ., Bloomington). EY-76-C-02-0016. *Phys. Lett., B;* **89**: No. 1, 26-30(31 Dec 1979).

The distorted wave impulse approximation (DWIA) is used to calculate angular distributions for $^{12}C(K^-,\pi^-)$/sub $\Lambda/^{12}C$ at 800 MeV/c. The results are compared with recent Brookhaven data.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

35732 Approximate dynamical symmetry in lattice quantum chromodynamics. Weinstein, M.; Drell, S.D.; Quinn, H.R.; Svetitsky, B. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF. *Phys. Rev., D;* **22**: No. 5, 1190-1197(1 Sep 1980).

We discuss the phenomenological implications of an approximate SU(6) x SU(6) x U(1) symmetry of hadron physics which remains after dynamical symmetry breaking in the strong-coupling lattice gauge theory. This symmetry is similar to but differs in an essential fashion from previous versions of SU(6) x SU(6) or SU(6)/sub W/. The difference resolves some of the problems of the older schemes: for example, although we obtain the "good" result μ/sub p//μ/sub n/ = -3/2, we avoid the "bad" result g/sub A//g/sub V/ = -5/3. We find that mesons are better approximated as irreducible representations of an SU(6)/sub W/ than static SU(6). Vector mesons are pseudo-Goldstone bosons in our scheme, which explains

why the sum rules for their masses should be written in terms of mass squared, like those of the pseudoscalars.

35733 Why is B-L conserved and baryon number not in unified models of quarks and leptons?. Lipkin, H.J. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **45**: No. 5, 311-313(4 Aug 1980).

Conservation of B: L and nonconservation of B are shown to follow simply from the weak isospin properties of quarks and leptons; namely that left-handed particles and right-handed antiparticles have weak isospin 1/2, that all other fermions are singlets, and that particles with half-integral isospin can only be created or annihilated in pairs.

35734 Asymptotic-freedom scales. Creutz, M. (Physics Department, Brookhaven National Laboratory, Upton, New York 11974). DE-AC02-76CH00016. *Phys. Rev. Lett.;* **45**: No. 5, 313-316(4 Aug 1980).

Using Monte Carlo methods with Wilson's lattice cutoff, the asymptotic-freedom scales of SU(2) and SU(3) gauge theories without quarks are calculated.

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 35715

FIELD THEORY

REFER ALSO TO CITATION(S) 35712, 35714, 35717, 35719, 35723, 35725, 35726, 35729, 35732, 35734

35735 (LBL—11295) **Vortex operators in gauge field theories.** Polchinski, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 132p. NTIS, PC A07/MF A01.

Thesis.

Several related aspects of the 't Hooft vortex operator are studied. The current picture of the vacuum of quantum chromodynamics, the idea of dual field theories, and the idea of the vortex operator are reviewed first. The Abelian vortex operator written in terms of elementary fields and the calculation of its Green's functions are considered. A two-dimensional solvable model of a Dirac string is presented. The expression of the Green's functions more neatly in terms of Wu and Yang's geometrical idea of sections is addressed. The renormalization of the Green's functions of two kinds of Abelian looplike operators, the Wilson loop and the vortex operator, is studied; for both operators only an overall multiplicative renormalization is needed. In the case of the vortex this involves a surprising cancellation. Next, the dependence of the Green's functions of the Wilson and 't Hooft operators on the nature of the vacuum is discussed. The cluster properties of the Green's functions are emphasized. It is seen that the vortex operator in a massive Abelian theory always has surface-like clustering. The form of Green's functions in terms of Feynman graphs is the same in Higgs and symmetric phases; the difference appears in the sum over all tadpole trees. Finally, systems having fields in the fundamental representation are considered. When these fields enter only weakly into the dynamics, a vortex-like operator is anticipated. Any such operator can no longer be local looplike, but must have commutators at long range. A U(1) lattice gauge theory with two matter fields, one singly charged (fundamental) and one doubly charged (adjoint), is examined. When the fundamental field is weakly coupled, the expected phase transitions are found. When it is strongly coupled, the operator still appears to be a good order parameter, a discontinuous change in its behavior leads to a new phase transition. 18 figures.

35736 New relation between semisimple Lie algebras. Patera, J.; Sharp, R.T.; Slansky, R. (Centre de recherches de mathematiques appliquees, Universite de Montreal, Montreal, Quebec, Canada). W-7405-ENG-36. *J. Math. Phys. (N.Y.);* **21**: No. 9, 2335-2341(Sep 1980).

A recently discovered relation between pairs of semisimple Lie algebras is further investigated. This relation, which is called subjoining and denoted by ">", is a generalization of inclusion, where a subalgebra is embedded in an algebra. Nontrivial subjoinings of two algebras of the same type are described. New chains of algebras involving proper inclusions and subjoinings can be formed. Infinite families of maximal subjoinings C/sub n/>B/sub n/ and B/sub n/>C/sub n/ are shown.

PHYSICS RESEARCH

NUCLEAR PHYSICS

35737 (LBL—11118) **Proceedings of the international conference on nuclear physics, August 24-30, 1980, Berkeley, California. Volume 1. Abstracts.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 973p. (CONF-800863—(absts.)). NTIS, PC A99/MF A01.

From International conference on nuclear physics; Berkeley, CA, USA (24 Aug 1980).

This volume contains all abstracts (931) received by the conference organizers before June 20, 1980. The abstracts are grouped according to the following topics: nucleon-nucleon interactions, free and in nuclei; distribution of matter, charge, and magnetism; exotic nuclei and exotic probes; giant resonances and other high-lying excitations; applications of nuclear science; nuclei with large angular momentum and deformation; heavy-ion reactions and relaxation phenomena; new techniques and instruments; pion absorption and scattering by nuclei; and miscellaneous. Some of these one-page abstracts contain data. A complete author index is provided. (RWR)

EXPERIMENTAL TECHNIQUES

35738 (LA-UR—80-2395) **Absolute polarization standards at medium and high energies.** McNaughton, M.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 13p. (CONF-800824—19). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

Although measurement of a polarization asymmetry is rather easy, the normalization of the measurement to obtain the analyzing power requires an absolute knowledge of the beam polarization or comparison with a known standard analyzing power. Such calibration standards can be hard to find. This paper concentrates on medium and higher energies, and divides the techniques into four categories: double scattering, polarized target methods, polarized source methods, and theoretical methods. Secondary standards are also discussed, and earlier data are assessed. 52 references, 6 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 35689

NUCLEAR REACTIONS AND SCATTERING

35739 Reactions p + d → ^{3}He + γ at intermediate energy. Prats, F. (George Washington Univ., Washington, DC (USA). Dept. of Physics). *Phys. Lett., B;* **88**: No. 1/2, 23-26(3 Dec 1979).

Angular distributions are calculated by dispersion methods. The reaction amplitude contains, besides proton and deuteron pole diagrams (direct terms), triangular diagrams associated with the quasi-deuteron mechanism. The ^{3}He vertices are from quasi-free scattering experiments at high energy.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

35740 Evidence for a 2^+ resonance in ^{4}He at 40 MeV. McBroom, R.C.; Weller, H.R.; Manglos, S.; Roberson, N.R.; Wender, S.A.; Tilley, D.R.; Skopik, D.M.; Arnold, L.C.; Seyler, R.G. (University of Florida, Gainesville, Florida 32611). *Phys. Rev. Lett.;* **45**: No. 4, 243-246(28 Jul 1980).

The fore-aft asymmetry in the angular distribution of the reaction ^{3}H(p,γ_0)^{4}He has been measured as a function of energy for protons from 17 to 31 MeV. The same quantity was also measured using the reaction ^{4}He(e,^{3}H)pe'. These asymmetry data were fitted with an expression which consisted of a term which varied slowly with energy plus a 2^+ resonance having parameters of Γ/sub cc/=3.5 MeV and E/sub x/(res)=40.2 MeV.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35740

35741 Reaction mechanisms and isospin effects for the π^{+-} + D → p + π^{+-} + n processes at P/sub π/ = 340 MeV/c. Hoftiezer, J.H.; Furic, M.; Mutchler, G.S.; Duck, I.M.; Dragoset, W.H.; Clement, J.M.; Judd, D.M.; Felder, R.D.; Pepin, G.P.; Witsch, W. von . DE-AC05-76ERO 1316/ EY-76-S-05-3948. *Phys. Lett., B;* **88**: No. 1/2, 73-75(3 Dec 1979).

The first kinematically complete counter measurements of the D(π^{+-},pπ^{+-}) π reactions in the Δ(1232) region are reported. Calculations based on low-order diagrams compare well with the data. The ratio pπ^{+}/pπ^{-} depends strongly on the spectator particle momentum, and its behavior is qualitatively reproduced.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

REFER ALSO TO CITATION(S) 35731

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35707, 35757

35742 (LBL—11320) **Two-particle correlations in nuclear collisions.** Tanihata, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01.

Two-particle correlations in proton-nucleus and nucleus-nucleus collisions were measured with beams of 800 MeV/A at the Berkeley Bevalac to study the reaction mechanism in more detail. Results were obtained that give information about the mean free path of protons in the nucleus, the contribution of the single-knock-out process in the collisions between equal-size nuclei, and the nuclear shadowing effect in collisions with a heavy target nucleus. 3 figures. (RWR)

35743 Systematics of back angle ^{12}C scattering - the ^{12}C + ^{20}Ne and ^{12}C + ^{24}Mg systems. Ford, J.L.C. Jr.; Campo, J.G. del; Shapira, D. (Oak Ridge National Lab., TN (USA)); Clover, M.R.; DeVries, R.M.; Fulton, B.R.; Ost, R. (Rochester Univ., NY). W-7405-ENG-26. *Phys. Lett., B;* **89**: No. 1, 48-51(31 Dec 1979).

The back-angle scattering of ^{20}Ne and ^{24}Mg ions from ^{12}C display structured excitation functions and oscillatory angular distributions. These measurements bridge the gap between the previously studied ^{12}C + ^{16}O and ^{12}C + ^{28}Si systems.

35744 Coincidence measurements of the reactions ^{12}C(π^{+-},π^{+-} d)^{10}B and ^{12}C(π^{+-},π^{+-} t)^{9}B. Ellis, R.J.; Ziock, H.J.; Ziock, K.O.H. (Virginia Univ., Charlottesville (USA). Dept. of Physics); Bolger, J.; Boschitz, E. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Karlsruhe Univ. . *Phys. Lett., B;* **88**: No. 3/4, 253-256(17 Dec 1979).

We have measured the reactions ^{12}C(π^{+-},π^{+-} d)^{10}B and ^{12}C(π^{+-},π^{+-} t)^{9}B at an incident pion energy of 180 MeV, with two spectrometers in coincidence. The ratio sigma(π^{+},π^{+} d)/sigma(π^{-},π^{-} d) agrees with the iso-spin prediction of unity. There is evidence for quasi-elastic πd scattering. We obtain the surprising result that the ratio sigma(π,πd)/sigma(π,πp), for excitation energies less than 10 MeV, is equal to the ratio (dsigma/dΩ) (πd)/(dsigma/dΩ)(πp) for elastic (πd) and (πp) scattering at all the points we have measured. The ratio sigma(π^{-},π^{-} t)/sigma(π^{+},π^{+} t) is approximately one and there is no evidence for quasi-elastic πt scattering.

35745 Studies of the pion double-charge exchange reaction ^{18}O(π^{+},π^{-})^{18}Ne. Greene, S.J.; Braithwaite, W.J.; Holtkamp, D.B.; Cottingame, W.B.; Moore, C.F. (Texas Univ., Austin (USA)); Morris, C.L.; Thiessen, H.A. (Los Alamos Scientific Lab., NM). *Phys. Lett., B;* **88**: No. 1/2, 62-64(3 Dec 1979).

Results of the first measurement of the excitation function of the cross section d sigma/dΩ for the pion double charge exchange reaction across the (3,3) π-nucleon resonance are reported. Data from the reaction ^{18}O(π^{+},π^{-})^{18}Ne to the double isobaric analog state at an angle of 5° are presented which show strong structure as a function of pion energy, in contrast to the previous limited data. The measurements were made with the EPICS facility at LAMPF which was modified to allow for data-taking at small angles.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

35746 Observation of the high-energy octupole giant resonance with 800-MeV protons. Carey, T.A.; Cornelius, W.D.; DiGiacomo, N.J.; Moss, J.M.; Adams, G.S.; McClelland, J.B.; Pauletta, G.; Whitten, C.; Gazzaly, M.; Hintz, N.; Glashausser, C. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **45**: No. 4, 239-242(28 Jul 1980).

Inelastic scattering of 800-MeV protons from ^{40}Ca, ^{116}Sn, and ^{208}Pb shows a broad giant resonance at an excitation energy of 110/A/sup 1/3/ MeV. The angular distributions are consistent only with scalar-isoscalar l=3 transfer. The excitation energy and width of this high-energy octupole giant resonance are in reasonable accord with theory. However its energy-weighted sum-rule strength (~20%) is only about one-half that predicted by random- phase-approximation calculations.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35746

35747 Search for shock waves in relativistic nucleus-nucleus collisions. Jain, P.L.; Das, G.; Cheng, B.T.; Aliakbar, Y. (State Univ. of New York, Buffalo (USA). Dept. of Physics). *Phys. Lett., B;* **88**: No. 1/2, 189-191(3 Dec 1979).

An analysis of central collisions by 1.9, 0.95, 0.50 GeV/nucl Fe and 1.9 GeV/nucl argon beams in nuclear emulsion is presented. Angular and rapidity distributions of the secondary particles do not support the presence of nuclear shock waves.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

REFER ALSO TO CITATION(S) 35742

ENERGY LEVELS AND TRANSITIONS

35748 Calculation of low-lying collective states in even-even nuclei. Iachello, F.; Puddu, G.; Scholten, O. (Yale Univ., New Haven, CT (USA). Dept. of Physics; Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Instituut); Arima, A.; Otsuka, T. (Tokyo Univ. . Contract EY-76-C-02-3074. *Phys. Lett., B;* **89**: No. 1, 1-4(31 Dec 1979).

We present results of a calculation of the low-lying collective quadrupole states in even-even nuclei within the framework of the proton-neutron interacting boson model.

NUCLEAR REACTIONS AND SCATTERING

35749 (UCID—18759) **Study of gamma-ray strength functions.** Gardner, D.G.; Gardner, M.A.; Dietrich, F.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Aug 1980. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01.

The use of gamma-ray strength function systematics to calculate neutron capture cross sections and capture gamma-ray spectra is discussed. The ratio of the average capture width, Γ/sub γ/-bar, to the average level spacing, D/sub obs/, both at the neutron separation energy, can be derived from such systematics with much less uncertainty than from separate systematics for values of Γ/sub γ/-bar and D/sub obs/. In particular, the E1 gamma-ray strength function is defined in terms of the giant dipole resonance (GDR). The GDR line shape is modeled with the usual Lorentzian function and also with a new energy-dependent, Breit-Wigner (EDBW) function. This latter form is further parameterized in terms of two overlapping resonances, even for nuclei where photonuclear measurements do not resolve two peaks. In the mass ranges studied, such modeling is successful for all nuclei away from the N = 50 closed neutron shell. Near the N = 50 shell, a one-peak EDBW appears to be more appropriate. Examples of calculated neutron capture excitation functions and capture gamma-ray spectra using the EDBW form are given for target nuclei in the mass-90 region and also in the Ta-Au mass region. 20 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 35751

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 35750

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 35751

35750 Nuclear data sheets for A=115. Harmatz, B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Nucl. Data Sheets;* **30**: No. 3, 413-499(Jul 1980).

Nuclear structure information pertaining to A=115 has been reviewed. The level properties obtained from decay and reaction experiments are shown in the drawings. Experimental methods, references, and comments are given in the text.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35746, 35752

35751 Alpha-cluster pickup from Te and Sn isotopes with the (d,^{6}Li) reaction. Jaenecke, J.; Becchetti, F.D. (Michigan Univ., Ann Arbor (USA). Dept. of Physics); Thorn, C.E. (Brookhaven National Lab., Upton, NY (USA)). *Nucl. Phys., A;* **325**: No. 2-3, 337-388(1979).

The reactions $^{122\ 124\ 126\ 128\ 130}$Te(d,^{6}Li)$^{118\ 120\ 122\ 124\ 126}$Sn and $^{112\ 116\ 118\ 120\ 122\ 124\ 126}$Sn(d,^{6}Li) $^{108\ 112\ 114\ 116\ 118\ 120}$Cd have been investigated at E/sub d/=33 MeV for states up to E/sub x/=3 MeV or higher by using magnetic analysis. Alpha-particle spectroscopic factors and reduced α-widths have been extracted with zero- and finite-range distorted wave Born approximation (DWBA) theory. Spectroscopic amplitudes were calculated from shell-model configurations including core excitations, and a semi-microscopic analysis was performed for ground-state transitions, proton pairing vibrational states, as well as certain states with J/sup π/ not equal to 0$^+$. Good agreement is obtained for the transitions to the Cd ground states provided DWBA is normalized to α-decay. The ground states and proton pairing vibration states in the heavy Sn isotopes appear to be strongly mixed. Increased collectivity, predicted by the interacting boson model, affects the excitation energies and transition strengths of the 0$^+$ proton pairing vibration states in Sn in the middle of the neutron shell. Selectivity and coherence phenomena are also prevalent for states with J/sup π/ not equal to 0$^+$ and are interpreted microscopically. In particular, coherent contributions from proton pair and neutron pair excitations lead to enhancements not observed in two-nucleon transfer. The mass excess of ^{120}Cd was measured as -83975+-25 keV. About 25 previously unknown states were observed in the Sn and Cd isotopes and about 30 spin-parity assignments were made.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

REFER ALSO TO CITATION(S) 35749

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35754

SPONTANEOUS AND INDUCED FISSION

35752 Fission barrier of ^{153}Tb. Plasil, F.; Ferguson, R.L.; Hahn, R.L.; Obenshain, F.E.; Pleasonton, F.; Young, G.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev. Lett.;* **45**: No. 5, 333-336(4 Aug 1980).

The fission barrier of ^{153}Tb was found to be 28.5 +- 1.7 MeV, which is about 83% of the predicted liquid-drop value. This result is consistent with calculations of nuclear masses and with barriers obtained from ^{4}He-induced fission. Barrier estimates of (51—65)% of liquid-drop values deduced for nonrotating nuclei from results of others appear to be in error.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35749

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

35753 (DOE/ER/10365—1) **Nuclear structure studies of transitional nuclei. Progress report, October 1, 1979-August 31, 1980.** Yates, S.W. (Kentucky Univ., Lexington (USA)). 1980. Contract AS05-79ER10365. 20p. NTIS, PC A02/MF A01.

Systematic investigations of the nuclear level structures of stable heavy transitional nuclei are being performed by (n,n'γ) reaction spectroscopy. Detailed γ-ray excitation functions and angular distributions permit characterization of low-lying states, with particular emphasis on understanding collective excitations of both positive and negative parity. Questions regarding nuclear shapes, deformation effects, and the applicability of various nuclear models to these nuclei have been addressed. Completed studies of ^{194}Pt and ^{196}Pt reveal significant structural differences between these nuclei, and have led to studies of other transitional nuclei as the next step in a comprehensive examination of this mass region. Cross section systematics for the (n,n'γ) reaction are being developed and, where possible, γ-ray studies have been complemented by neutron detection time-of-flight measurements. 6 figures, 1 table.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35742, 35746, 35754, 35757

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 35352

NUCLEAR REACTIONS AND SCATTERING

35754 (COO—3496-75) **Studies of heavy ion reactions and transuranic nuclei. Progress report, August 1, 1979-July 31, 1980.** Huizenga, J.R. (Rochester Univ., NY (USA). Dept. of Chemistry and Physics). Jul 1980. Contract AS02-76ER03496. 252p. NTIS, PC A12/MF A01.

The study of heavy-ion reaction mechanisms at the SuperHILAC and LAMPF is reported. Preprints of five articles and manuscripts of four recent conference papers are given, along with complete citations of publications and a list of personnel. Significant work was performed in the following areas: the bombarding energy dependence of the ^{209}Bi + ^{136}Xe reaction; the fragment yields for specific Z and A for projectile-like fragments produced in the reaction of 8.3-MeV/u ^{56}Fe ions with targets of ^{56}Fe, ^{165}Ho, ^{209}Bi, and ^{238}U; and time distributions of fragments from delayed fission after muon capture for muonic ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, and ^{242}Pu. (RWR)

NUCLEAR THEORY

35755 Time-dependent Hartree-Fock phase: Unique implication of variational principle. Lichtner, P.C.; Griffin, J.J.; Schultheis, H.; Schultheis, R.; Volkov, A.B. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). *Phys. Lett., B;* **88**: No. 3/4, 221-225(17 Dec 1979).

The time-dependent Hartree-Fock (TDHF) variational principle is shown to yield a unique solution with no indeterminacy in its time-dependent phase. The long-standing contrary opinion arises from an impermissible restriction to norm-preserving variations.

NUCLEAR MATTER

35756 Charge-constrained coherent pion states produced in nuclear matter. Kauffmann, S.K.; Gyulassy, M. (California Univ., Berkeley (USA). Div. of Nuclear Science). Contract W-7405-ENG-48. *Nucl. Phys., A;* **333**: No. 3, 392-298(Jan 1980).

In a recent article, Bloss, Hone and Scalapino have used a simplified model Hamiltonian and Keldysh field theoretic methods to calculate approximately the power radiated as Cherenkov charged pions whose emission is triggered when a fast nucleon traverses nuclear matter. The model used by these authors conserves charge by flipping the isospin state of the fast nucleon alone for each charged pion emitted. Since it is the nuclear matter excited by the fast nucleon which should be largely reponsible for emitting the Cherenkov charged pions, we investigate an alternate model that allows all the disturbed nuclear matter to change its charge state when a charged pion is emitted - as an idealization, the emitting matter is assumed to have an infinite number of charge states, in contrast to the two of the fast nucleon. This modified model is shown to be exactly solvable in terms of charge-constrained coherent pion states; the power radiated as charged pions is found to be approximately twice that calculated by Bloss et al. from their model.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 35756

35757 (DOE/ER/10364—12) **Introduction to the study of collisions between heavy nuclei.** Bayman, B.F. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1980. Contract AC02-79ER10364. 86p. NTIS, PC A05/MF A01.

Current investigations concerning the collisions of nuclei governed by small de Broglie wavelengths are reviewed. The wave packets localize nuclei in regions small compared to their diameters. Cross sections are examined for potential scattering, elastic scattering, quasi-molecular states, peripheral particle-transfer reactions, fusion, and deep inelastic collisions. Theories of fusion and deep

inelastic collisions are summarized. This paper is in the nature of a review-tutorial. 45 references, 51 figures, 2 tables. (RWR)

35758 Selection of central events in intermediate energy heavy-ion collisions. Wong, Cheuk-Yin (Oak Ridge National Lab., TN (USA)). Contract W-7405-ENG-26. *Phys. Lett., B;* **88**: No. 1/2, 39-42(3 Dec 1979).

We introduce the centrality parameter which measures the degree of departure from axial symmetry of the reaction products in a nearly head-on collision. The centrality parameter can be used to select events which are nearly head-on in order to facilitate comparison of experimental results with theoretical predictions.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 35748

RADIATION AND SHIELDING PHYSICS

35759 (SAND—80-1069) **Some singular integral equations in linear transport theory.** Mullikin, T.W. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01.

Solutions to the steady-state transport equation for one speed, isotropic scattering in a half-space can be found from singular integral equations with Cauchy principal-value integrals. Galerkin methods for these equations are studied with special emphasis on sensitivity of approximation errors to choice of basis.

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 35214, 35353, 35675

35760 (CONF-800944—2) **Calculated distance distributions of energy transfer events in irradiated liquid water.** Hamm, R.N.; Turner, J.E.; Wright, H.A.; Ritchie, R.H. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From 7. symposium on microdosimetry; Oxford, UK (8 Sep 1980).

Histories from a Monte Carlo electron transport calculation in liquid water are analyzed to obtain the distance distribution functions, t(x) and T(x), of energy transfer events. These functions, which give the average energy transferred within a distance x from an arbitrary transfer event, are presented for irradiation by monoenergetic electrons of several energies between 500 eV and 1 MeV, for monoenergetic photons of 10, 50, and 200 keV energy and for 65 kVp and 200 kVp x rays and ^{60}Coγ rays. The dose average lineal energy in spherical sites as a function of site radius is also presented for these same photon spectra.

35761 Combined Monte Carlo diode simulation code. Quintenz, J.P.; Widner, M.M. (Sandia Laboratories, Particle Beam Fusion Research Department, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **51**: No. 9, 4688-4692(Sep 1980).

A collisional Monte Carlo electron transport model has been combined with an existing relativistic electron beam diode simulation code to investigate the effect of electron material interactions on diode performance. The effects of electron scattering and deposition in various anode materials on the electron beam profile are detailed. Simulations of two enhanced electron deposition experiments are described.

35762 Singular eigenfunctions for linear transport in an exponential atmosphere. Larsen, E.W.; Pomraning, G.C.; Badham, V.C. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Math. Phys. (N.Y.);* **21**: No. 9, 2448-2454(Sep 1980).

We prove that under an explicit condition on the parameters in the isotropic-scattering linear transport equation for an exponential atmosphere, the continuum eigensolutions developed by Millikin and Siewert are complete on the half range $0<\mu<$ or $=1$. We also treat numerically the equation for the outgoing flux, which can be derived using these eigenfunctions, and we show that excellent numerical results are obtained if the above condition is satisfied, while poor results are obtained if the condition is sufficiently violated. Finally, we describe a method for constructing elementary solutions of the anisotropic-scattering transport equation for an exponential atmosphere.

35763 Optical properties of polyethylene: measurement and applications. Painter, L.R.; Arakawa, E.T.; Williams, M.W.; Ashley, J.C. (Oak Ridge National Lab., TN). *Radiat. Res.;* **83**: No. 1, 1-18(Jul 1980).

The optical properties of polyethylene, obtained from transmission measurements on thin films, are presented for photon energies from 0.5 to 76 eV. The results for the extinction coefficient are combined with calculated values in the soft and hard x-ray regions, and both their internal consistency and their consistency with data obtained previously for polystyrene are verified through a sum rule calculation. Based on these optical data, the mean excitation energy for polyethylene is calculated to be 62 eV. A model insulator theory, with parameters fixed by the optical data, is employed to calculate inverse mean free paths and energy losses per unit pathlength for low-energy electrons (10 eV through 10 keV) in polyethylene.

NEUTRON INTERACTIONS WITH MATTER

35764 (LA—8374-MS) **Graphs of the cross sections in the recommended Monte Carlo cross-section library at the Los Alamos Scientific Laboratory.** Soran, P.D.; Seamon, R.E. (Los Alamos Scientific Lab., NM (USA)). May 1980. Contract W-7405-ENG-36. 429p. NTIS, PC A19/MF A01.

Graphs of all neutron cross sections and photon production cross sections on the Recommended Monte Carlo Cross Section (RMCCS) library have been plotted along with local neutron heating numbers. Values for anti ν, the average number of neutrons per fission, are also given.

35765 Measurement of the transverse range of (n,2n) recoils in Au. Roberto, J.B.; Robinson, M.T. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *J. Appl. Phys.;* **51**: No. 9, 4589-4591(Sep 1980).

The lateral spread of ~100 keV recoils in Au foils has been determined by a radioactive counting technique. A uniform distribution of recoils initially moving nearly parallel to the foil surfaces was generated by (n,2n) reactions with a high-energy neutron beam from a cyclotron. The fraction of (n,2n) activity which escapes the transverse surface is a measure of the transverse spreading of the recoils. Projected ranges were measured by orienting some of the foils perpendicular to the incident neutron beam. The experimental results are in excellent agreement with the predictions of the MARLOWE binary collision code, and indicate that the transverse range $< x>$ of ~100 keV self-ions in Au is approximately one-sixth of the projected range.

35766 Positron-lifetime study of copper irradiated by d-T fusion neutrons. Howell, R.H. (Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1722-1728(15 Aug 1980).

Positron-lifetime characteristics have been investigated for samples of pure annealed copper irradiated by d-T fusion neutrons to a fluence of 5×10^{16} n/cm^2. It is found that the general characteristics of the data are similar to those obtained from proton irradiation under similar circumstances. While there are minor differences in the dose dependence, trap lifetime, and recovery between the two irradiations, there is quantitative agreement between the trapping-rate data and calculated damage production when damage from recoils below 50 keV is excluded.

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

35767 Recommended standards for gamma-ray energy calibration (1979). Helmer, R.G.; Assche, P.H.M.V.; Leun, C.V.D. (inverted-triangle-solidask group of the Commission on Atomic Masses and Fundamental Constants of the International Union of Pure and Applied Physics). *At. Data Nucl. Data Tables;* **24**: No. 1, 39-48(Jul 1979).

A consistent set of γ-ray energies, all with uncertainties of at most 10 ppm, is recommended for use in the energy calibration of γ-ray spectra. Almost all γ rays listed are from commercially available sources. The half-lives of the isotopes selected are generally at least 30 days. The γ-ray energies, in the range E/sub γ/=60—6100 keV, are all based on the value of 411 804.4 +- 1.1 eV for the γ-ray from the decay of ^{198}Au. The energy of the 6129-keV line in ^{16}O, which is the γ-ray with the highest energy of the present set, has also been measured relative to another standard: the two values are consistent.

35768 γ-ray energies for ^{40}K, /sup 108m/Ag and the ^{226}Ra decay chain. Helmer, R.G.; Gehrke, R.J.; Greenwood, R.C. (Idaho National Engineering Lab., Idaho Falls (USA)). *Nucl. Instrum. Methods;* **166**: No. 3, 547-549(1 Dec 1979).

The energies of several γ rays from long-lived sources have been measured to provide calibration lines for Ge semiconductor detectors. Energy values obtained are as follows: for ^{40}K, 1460.830(5) keV; and for ^{108}mAg 433.936(4), 614.281(4) and 722.929(4) keV. Values for thirteen γ-rays in the ^{226}Ra decay chain from 609-2447 keV are also given.

DOSIMETRY

REFER ALSO TO CITATION(S) 35507, 35508, 35509

35769 (CONF-800944—4) **Interface effects on dose distributions in irradiated media.** Wright, H.A.; Hamm, R.N.; Turner, J.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From 7. symposium on microdosimetry; Oxford, UK (8 Sep 1980).

It has long been recognized that nonuniformities in dose distributions may occur in the immediate vicinity of a boundary between two different media. Considerable work has been done to determine interface effects in media irradiated by photons or in media containing β- or α-particle emitters. More recently interface effects have become of interest in additional problems, including pion radiotherapy and radiation effects in electronic microcircuits in space vehicles. These problems arise when pion capture stars or proton-nucleus interactions produce a spectrum of charged nuclear fragments near an interface. The purpose of this paper is to examine interface effects in detail as to their specific origin. We have made Monte Carlo calculations of dose distributions near an interface in a systematic way for a number of idealized cases in order to indicate the separate influences of several factors including different stopping powers of the two media, nonconstancy (e.g., Bragg peak) in the energy loss curve for the particles, different particle spectra in the two media, and curvature of the boundary between the two media.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 34634, 34637, 34647, 35157, 35161, 35677, 35850

35770 (CONF-800864—1) **Rigid muffin-tin approximation for the electron-phonon interaction in transition metals.** Butler, W.H. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01.

From International conference on physics of transition metals; Leeds, UK (18 Aug 1980).

Progress in calculating the electron-phonon parameters of transition metals has been based on either the rigid muffin-tin approximation (RMTA) or the fitted modified tight-binding approximation (FMTBA). The RMTA has been shown to be remarkably accurate for average electron-phonon properties, but there are indications that RMTA matrix elements may be too small at low momentum transfer. An attempt is made to demonstrate these assertions concerning the accuracy of RMTA and the numerous electron-phonon calculations are placed in a broader perspective by a demonstration of how they can be used to explain the trends in the strength of the electron-phonon coupling among the transition metals and the A-15 compounds. (GHT)

35771 (DOE/TIC—11225) **Surface and catalysis science in the Materials and Molecular Research Division.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1980. Contract W-7405-ENG-48. 69p. NTIS, PC A04/MF A01.

Surface science studies at Lawrence Berkeley Laboratory are detailed. Subject areas include: structure of surfaces and adsorbed monolayers; reduction and oxidation of surfaces; catalytic chemistry; and structure of interfaces and thin films. (GHT)

35772 (LA—8410-MS) **Thickening of a shock front by the grain structure of a solid.** Mjolsness, R.C. (Los Alamos Scientific Lab., NM (USA)). Jul 1980. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01.

Three possible mechanisms: (1) microchanneling of a shock front; (2) variations of sound speed with direction in a grain; and (3) refraction of shock front direction on passing from grain to grain, all seem able to cause an initially steady, 1-D shock front to effectively thicken into a fluctuating, irregular shock front described by a shock front envelope. The shock front envelope diffuses in width to the order of one to several grain diameters, when it presumably reaches a steady state width. The treatment is confined to estimating the initial rate of widening of the shock front envelope by the simplest reasonable models, so no properties of the conjectured final state shock structure have been established.

35773 (LA-UR—80-2385) **Zero and finite field μSR in spin glass Ag:Mn.** Brown, J.A.; Dodds, S.A.; Estle, T.L.; Heffner, R.H.; Leon, M.; MacLaughlin, D.E.; Olsen, C.E.; Schillaci, M.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800855—1). NTIS, PC A02/MF A01.

From 2. international topical meeting on muon spin rotation; Vancouver, BC, Canada (Aug 1980).

Muon spin rotation data taken in both zero and finite fields are presented for a Ag:Mn (1.6 at %) spin glass sample. The data enable determination of the fluctuation rate of the Mn ions as a function of temperature. (GHT)

35774 (LBL—9881, pp 151-160) **Standard Crystallographic File Structure: 79 (trial version).** 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

A preliminary version of a Standard Crystallographic File Structure that could be used for the transfer of machine-readable files of crystallographic data between laboratories is presented. Although not intended to be comprehensive, it contains the essential elements needed for a crystal structure file. (RWR)

35775 **Tunneling transmission coefficients for electrons through (100) GaAs—Ga/sub 1-x/Al/sub x/As—GaAs heterostructures.** Osbourn, G.C. (Sandia Laboratories, Albuquerque, New Mexico 87185). *J. Vac. Sci. Technol.;* **17**: No. 5, 1104-1107(Sep 1980).

We present calculations of tunneling transmission coefficients for electrons through (100) GaAs-Ga/sub 1-x/Al/sub x/As—GaAs heterostructures. The calculations were performed using the empirical tight binding approximation. For sufficiently thick alloy regions, the tunneling probability is an exponential which decays with alloy thickness multiplied by a prefactor which is independent of alloy thickness. We have investigated the dependence of the tunneling prefactors on incident electron wavevector and alloy composition x. For the prefactors, we find a strong dependence on the incident electron wavevector component, normal to the interfaces and the alloy composition x, and a weak dependence on the incident electron wavevector component parallel to the interface for the energy range of interest.

35776 **Theory of the structure and lattice dynamics of incommensurate solids: A classical treatment.** Novaco, A.D. (Lafayette College, Easton, Pennsylvania 18042). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1645-1659(15 Aug 1980).

A classical theory of the static strains and lattice dynamics for solids possessing incommensurate structures is developed using a spatial Fourier representation of the static strains and a space-time Fourier representation of the dynamical modes. Although the theory is presented for one-dimensional systems, the general technique is not restricted to such systems and can be applied in a straightforward manner to problems in two or three dimensions. A set of coupled, nonlinear equations is derived for the amplitudes and phases of the strains and a controllable sequence of approximations is described for finding the solutions to these equations. Excellent results are obtained using only low-order terms in various truncated expansions even for those cases where the domain walls are quite narrow. It is shown that provided the amplitudes of the dynamical oscillations are small enough, normal modes do exist even in the limit of large static strains. However, these modes are not characterized by a single wave vector but rather have important contributions from density fluctuations of various wavelengths. Strong evidence is given for the energy at zero kelvin of the one-dimensional system being a nonanalytic function of the mean lattice spacing of the type described by Aubry. This means that the pressure is a discontinuous function of the mean spacing with discontinuities existing at rational values of this spacing. The sizes of these discontinuities decrease rapidly as the order of the commensurate state increases. Each commensurate state would thus exist over a finite pressure range and the system will exhibit a "devil's-stair" behavior at zero kelvin.

35777 **Analytic representation for first-principles pseudopotentials.** Lam, P.K.; Cohen, M.L.; Zunger, A. (Department of Physics, University of California, Berkeley, California 94720). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1698-1708(15 Aug 1980).

The first-principles pseudopotentials developed by Zunger and Cohen are fit with a simple analytic form chosen to model the main physical properties of the potentials. The fitting parameters for the first three rows of the Periodic Table are presented, and the quality of the fit is discussed. The parameters reflect chemical trends of the elements. We find that a minimum of three parameters is required to reproduce the regularities of the Periodic Table. Application of these analytic potentials is also discussed.

SOLID STATE PLASMA

35778 (LBL—11252) **Surface nonlinear optics.** Shen, Y.R.; Chen, C.K.; de Castro, A.R.B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; California Univ., Berkeley (USA). Dept. of Physics). 1980. Contract W-7405-ENG-48. 9p. (CONF-8006113—1). NTIS, PC A02/MF A01.

From Sergio Porto Memorial symposium on lasers and applications; Rio de Janiero, Brazil (29 Jun 1980).

Surface electromagnetic waves are waves propagating along the interface of two media. Their existence was predicted by Sommerfield in 1909. In recent years, interesting applications have been found in the study of overlayers and molecular adsorption on surfaces, in probing of phase transitions, and in measurements of refractive indices. In the laboratory, the nonlinear interaction of

surface electromagnetic waves were studied. The preliminary results of this recent venture in this area are presented.

SUPERCONDUCTIVITY

35779 Irreversible thermodynamics of flow in solids. Wallace, D.C. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., B: Condens. Matter;* **22**: No. 4, 1477-1486(15 Aug 1980).

Dynamic deformation of solid materials is described in terms of nonuniform material motion and simultaneous thermoelastic strain and plastic flow. For deformations of arbitrary form and magnitude in an initially isotropic solid, an approximate expression for the entropy production is given, and the interrelations among the thermodynamic variables of stresses, elastic and plastic strains, and temperature and entropy are derived. The theory is specialized to plane-wave geometry, appropriate for describing a weak planar shock, and is compared with the relaxing solid model which has previously been used to analyze plane shocks in solids. A qualitative examination of the mechanics of elastic strain and plastic flow indicates that a thermodynamic description is accurate for many fast deformation processes in solids.

35780 Transition to zero vorticity in a two-dimensional superconductor. Ovadyahu, Z. (Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Phys. Rev. Lett.;* **45**: No. 5, 375-378(4 Aug 1980).

Data are presented that suggest the existence of a long-range topological order in thin superconducting films below a characteristic temperature.

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 35160

35781 (IS-M—293) **Effect of pressure on the superconducting and magnetic critical temperatures of bct ternary ruthenium borides.** Shelton, R.N.; Segre, C.U.; Johnston, D.C. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1980. Contract W-7405-ENG-82. 10p. (CONF-800954—2). NTIS, PC A02/MF A01.

From Ternary superconductors conference; Lake Geneva, WI, USA (24 Sep 1980).

The effects of hydrostatic pressure to 21 kbar on the superconducting (T/sub c/) and magnetic (T/sub m/) critical temperatures are reported for thirteen body-centered tetragonal isomorphous compounds in the systems $RERu_4B_4$ and $RE(Rh_{0.85}Ru_{0.15})_4B_4$ (RE=Pr,Nd,Gd,Tb,Dy,Ho,Er,Tm,Lu). Comparison of the two superconducting Lu compounds reveals a marked distinction between the volume dependence of T/sub c/ due to external pressure and the effect caused by alloying on the transition metal site which also affects unit cell volume. A contrasting behavior under pressure is observed for the magnetic and superconducting states for the three pairs of compounds comprised of RE=Dy,Ho,Er.

35782 (IS-M—295) **Superconductivity and long range magnetic order in the body-centered tetragonal system Er(Rh/sub 1-x/Ru/sub x/)$_4$B$_4$.** Horng, H.E.; Shelton, R.N. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1980. Contract W-7405-ENG-82. 10p. (CONF-800954—3). NTIS, PC A02/MF A01.

From Ternary superconductors conference; Lake Geneva, WI, USA (24 Sep 1980).

In the system Er(Rh/sub 1-x/Ru/sub x/)$_4$B$_4$, the compound $ErRu_4B_4$ orders magnetically at T/sub m/ = 2.1°K; whereas, compounds for $0.05 \leqq x \leqq 0.40$ become superconducting at T/sub c/ approximately greater than 7.5°K. The details of these low temperature states are investigated via a series of measurements on 19 samples with $0.05 \leqq x \leqq 1.00$. T/sub c/ is relatively composition independent up to $x \simeq 0.40$, followed by a sharp drop for x values between 0.40 and 0.50. This critical composition for the destruction of superconductivity, x/sub cr/ $\simeq$ 0.50, is not influenced by the magnetic properties of the rare earth. T/sub m/ is depressed when Rh is substituted for Ru and for this system superconductivity and long range magnetic order are mutually exclusive.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

35783 (LA-UR—80-2437) **Statistical mechanics of solitons.** Bishop, A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 19p. (CONF-800857—1). NTIS, PC A02/MF A01.

From Physics in one-dimension conference; Fribourg, Switzerland (25 Aug 1980).

The status of statistical mechanics theory (classical and quantum, statics and dynamics) is reviewed for 1-D soliton or solitary-wave-bearing systems. Primary attention is given to (i) perspective for existing results with evaluation and representative literature guide; (ii) motivation and status report for remaining problems; (iii) discussion of connections with other 1-D topics.

STATISTICAL PHYSICS AND THERMODYNAMICS

35784 Kinetics of an order-disorder transition. Phani, M.K.; Lebowitz, J.L.; Kalos, M.H.; Penrose, O. (Departments of Mathematics and Physics, Rutgers University, New Brunswick, New Jersey 08903). DE-AC02-76ER03077. *Phys. Rev. Lett.;* **45**: No. 5, 366-369(4 Aug 1980).

Novel computer simulations are described of the time evolution of an ordering model binary alloy following quenching from a disordered state at a high temperature. The results are interpreted with use of ideas of Lifshitz and of Cahn and Allen; the ordering process is described by a kinetic equation for the motion of the walls separating domains with different orderings. The characteristic length increases as t/sup 1/2/, and the structure function scales as kt/sup 1/2/.

ELECTRICITY AND MAGNETISM

35785 (UCRL—52803) **EMP coupling to ships.** Deadrick, F.J.; Cabayan, H.S.; Kunz, K.F.; Bevensee, R.M.; Martin, L.C.; Egbert, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 163p. NTIS, PC A08/MF A01.

Scale-model tests were conducted to establish the adequacy and limitations of model measurements as tools for predicting electromagnetic pulse (EMP) coupling voltages and currents to the critical antennas, cables, and metallic structures on ships. The scale-model predictions are compared with the results of the full-scale EMP simulation test of the Canadian ASW ship, HMCS Huron. (The EMP coupling predictions in this report were made without prior knowledge of the results of the data from the HMCS Huron tests.) This report establishes that the scale-model tests in conjunction with the data base from EMP coupling modules provides the necessary information for source model development and permits effective, low-cost study of particular system configurations. 184 figures, 9 tables.

35786 (UCRL—84437) **Parameter estimation from noisy transient electromagnetic measurements.** Gavel, D.T.; Candy, J.V.; Lager, D.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1980. Contract W-7405-ENG-48. 35p. (CONF-800842—1). NTIS, PC A03/MF A01.

From Nuclear EMP meeting; Anaheim, CA, USA (5 Aug 1980).

The study of the EMP phenomenon has promoted the development of techniques to investigate transient electromagnetic response data. Characterization of the EMP transient response information is necessary to evaluate the performance of that system in a hostile environment. An efficient technique to characterize this performance is to fit an electromagnetic model to the data. The performance of three different signal processing techniques applied to parameterize a body from noisy experimental electromagnetic transient response data is described. The techniques, which range from the well-known Prony method to the more sophisticated extended Kalman filter and finally to the highly sophisticated maximum likelihood identifier, are briefly described. The performance of these algorithms is compared, and their tradeoffs are discussed. 14 figures, 2 tables.

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

REFER ALSO TO CITATION(S) 35803

35787 (CONF-800932—3) **High beta studies on ISX-B with neutral beam injection.** Sheffield, J.; Bates, S.C.; Bush, C.E. (Junta de Energia Nuclear, Madrid (Spain); Oak Ridge National Lab., TN (USA); Japan Atomic Energy Research Inst., Tokyo). 1980. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

From 2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas; Como, Italy (3 Sep 1980).

Injection of H^0 into D^+ plasmas with beam power P/sub b/ of up to 1.7 MW has produced rms betas of ~ 4%, volume-averaged betas of ~ 3%, and central betas of ~ 10% in the ISX-B tokamak. Although theoretical calculations indicate that the observed equilibria may be unstable to ballooning modes, no catastrophic loss of confinement has been observed, and beta continues to increase with injection power. In these beam-dominated high-beta discharges the electron and ion energy confinement times are still similar to those obtained with ohmic heating: ion energy confinement is neoclassical within a factor of ~ 2, and electron energy confinement follows the usual Alcator scaling. In high-power injection discharges the character of the magnetohydrodynamic (MHD) behavior changes, the particle confinement time decreases, and the inward impurity transport appears to be inhibited. These effects, however, may not be linked directly to beta.

35788 (SAI—254-80-442-LJ) Collisonal end losses from conventional and tandem mirrors. Catto, P.J.; Bernstein, I.B. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.; Yale Univ., New Haven, CT (USA). Dept. of Engineering and Applied Science). Jul 1980. Contract AC03-76ET53057. 23p. (PRI—8). NTIS, PC A02/MF A01.

A simple variational procedure is employed to obtain an analytical expression for the collisional particle end loss rate in a mirror for the electrostatically confined species. The technique circumvents the need for an accurate solution for the distribution function, and yet reproduces the previous large mirror ratio, large barrier height results for the loss rate. The analytic result is also in remarkably good agreement with a numerical solution of the full linearized Fokker-Planck equation.

35789 Studies of an unneutral electron cloud confined in a multiple-mirrored toroidal magnetic field)/sup a/. Fisher, A.; Gilad, P.; Goldin, F.; Rostoker, N. (Physics Department, University of California, Irvine, California 92717). *Appl. Phys. Lett.;* **37**: No. 6, 531-532(15 Sep 1980).

An unneutral electron cloud of 3 x 10^{13} electrons with a number density of 10^{11} cm^{-3} was compressed and confined by a multiple-mirrored toroidal magnetic field. The radial electric field associated with this electron cloud was about 10^3 V/cm. The electrons, having a large magnetic moment, were confined by the magnetic mirrors. An upper limit of 1 A was set on the induced current when a toroidal electric field of 10 V/cm was applied. This puts a limit $n<4 \times 10^8$ cm^{-1} on the line density of electrons with perpendicular energy lower than 300 eV.

35790 Measurement of the plasma width in a ring cusp. Pechacek, R.E.; Greig, J.R.; Raleigh, M.; Koopman, D.W.; DeSilva, A.W. (Naval Research Laboratory, Washington, D.C. 20375). *Phys. Rev. Lett.;* **45**: No. 4, 256-259(28 Jul 1980).

A pure, fully ionized, D_2 plasma of 2 x 10^{19} ions, generated from free-falling D_2 pellets with use of a 100J Nd-Glass laser pulse followed by a 1000J CO_2 laser, pulse is used to fill ($\beta=1$) a cusp-configured magnetic field. The width of the plasma escaping through the ring cusp is determined by laser scattering, chamber wall light and chemical deposits, and plasma lifetime. The ring cusp is an ion gyroradius wide, in contrast to recent experiments that have indicated a considerably narrower cusp width.

35791 Stable confinement of a high-beta toroidal plasma. Prager, S.C.; Halle, J.H.; Phillips, M.W.; Post, R.S.; Twichell, J.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). *Nucl. Fusion;* **20**: No. 5, 635-638(May 1980).

A plasma with β approximately 12% has been stably confined in the Levitated Octupole. Although the single-fluid ballooning-instability beta limit is exceeded on the outer flux surfaces, no such mode is observed. Finite-ion-gyroradius effects may account for the observed stability. The single-fluid calculation indicates that the amplitude of the most unstable mode is nearly uniform along the magnetic field line with only slight peaking in the bad-curvature region. The particle confinement time is one quarter of the classical value.

35792 Bolometric measurements and the role of radiation in Alcator power balance. Scaturro, L.S.; Pickrell, M.M. (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). *Nucl. Fusion;* **20**: No. 5, 527-535(May 1980).

A bolometric study of global power balance on the Alcator A tokamak has shown that neither high- nor low-Z impurities play a dominant role in plasma energy confinement for 'well-behaved' discharges. Spatially and temporally resolved measurements of the power lost in radiation and particles have shown that in the region $0<r<3$ cm these loss mechanisms account for only 15% of the local Ohmic power input. The radiative losses from the central plasma regions are attributed to molybdenum. Variation of the emissivity with density has shown that radiative and particle losses become more important at densities less than $2x10^{14}$ cm^{-3}. A study of disruptive discharges and discharges showing anomalous increases in the plasma resistance has shown that radiation can be the dominant loss mechanism under these conditions.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 35792

35793 Real time digital spectral analysis as a plasma fluctuation diagnostic. Schoenberg, K.F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG. 36. *Rev. Sci. Instrum.;* **51**: No. 9, 1151-1158(Sep 1980).

A real time digital spectral analysis system, applicable to broad band plasma fluctuations, is presented. The system digitally records plasma potential fluctuations on a pair of matched electrostatic probes, and subsequently outputs the cross power spectral density and phase via an on-line computer graphics display. The spectral analysis system and its experimental accuracy are discussed. Using the Lawrence Berkeley Laboratory ten amp neutral beam ion source, several examples demonstrating the systems application to plasma wave detection are given.

35794 Electron distribution function measurement by harmonically driven electrostatic probes. Schoenberg, K.F. (University of California, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). *Rev. Sci. Instrum.;* **51**: No. 9, 1159-1162(Sep 1980).

An electron distribution function measurement system, applicable to noisy plasma environments, is presented. The system is based on the harmonic differentiation technique, which utilizes the nonlinearity of the probe current-voltage characteristic to infer distribution function structure. Measurements couple low noise, phase sensitive detection with digital data acquisistion and analysis, resulting in fast and accurate measurement in noisy environments where active electronic differentiation may prove untenable. The accuracy of the experimental technique and measurement system is discussed. Using a high power arc plasma, an example demonstrating the experimental system is given.

PLASMA KINETICS - EXPERIMENTAL

35795 Observations of arcing in the ISX tokamak. Mioduszewski, P.; Clausing, R.E.; Heatherly, L. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). *J. Nucl. Mater.;* **85**: No. 86, 963-966(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Arcing has been proposed as a major source metal impurities in tokamak plasmas. Arc tracks have been observed in the ISX tokamak on the limiter, the inner-wall surface, and on the samples from the surface analysis station. Linear as well as fern-like arc tracks have been observed. From optical and SEM analysis of the tracks, it was estimated that about 10^{16}-10^{17} atoms were released per arc. To study the influence of arcing on the tokamak discharge, an experiment was set up to measure electrical and optical signals of arcing in situ. In well controlled tokamak discharges, arcing was observed only during the inital breakdown of the plasma and during the quenching phase at the end of the discharge. In disrupted discharges, each plasma disruption was accompanied by arcing. The pulse-length of one single unipolar arc was measured to be about 50 μs and the current amplitude was typically about 20 A.

35796 Measurement of differential wall changes using surface probes in the Alcator-A tokamak. Robinson, J.E.; Marmar, E.S. (Massachusetts Inst. of Tech., Cambridge (USA)); Thompson, D.A.; Poehlman, S.W. (McMaster Univ., Hamilton, Ontario (Canada)). *J. Nucl. Mater.;* **85**: No. 86, 973-977(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Plasma impurities resulting from the limiters and walls of tokamaks are a recognized problem for fusion reactors. This paper reports recent measurements of impurity fluxes and differential changes at a surface probe near the plasma edge of Alcator-A. High purity aluminium samples were prepared and Auger analyzed in an interlocking UHV chamber using a retractable probe. Rutherford backscattering is used to determine the quantities of implanted species. Time resolved measurements are made by rotating a disc-shaped sample behind an aperature during discharges. Estimates are made for C, N, O, Fe and Mo fluxes at the plasma edge.

35797 Time-resolved measurements of impurity deposition in ISX. Zuhr, R.A.; Clausing, R.E.; Emerson, L.C.; Heatherly, L. (Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **85**: No. 86, 979-982(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Time-resolved measurements of impurity deposition were made in the plasma edge region of ISX-A. A cylindrical sample located 20 mm behind the limiter was exposed to the plasma in

synchronization with the discharges to give a time resolution of approx. 8 ms. The cylinder was withdrawn to an analysis chamber where the impurities deposited as a function of time were determined by Auger electron spectroscopy. Later analysis by Rutherford ion backscattering was used to quantify the results. The primary metallic impurities were identified as titanium, iron and chromium. The time evalution of of these impurities is correlated with conditions in the plasma during the discharge. All the impurities observed were found to accumulate on the sample at a minimum rate during the stable central portion of the discharge, and at maximum rate at times when the plasma was unstable.

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 35668

35798 (CONF-800950—2) **Comparison of calculated and experimental neutron attenuation and streaming data for fusion reactor design.** Santoro, R.T.; Alsmiller, R.G. Jr.; Barnes, J.M.; Chapman, G.T. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

Integral experiments that measure the neutron and gamma-ray energy spectra resulting from the attenuation of ~ 14 MeV T(D,n)^{4}He reaction neutrons in laminated slabs of stainless steel type 304, borated polyethylene, and a tungsten alloy (Hevimet) and from neutrons streaming through a 30-cm-diameter iron duct (L/D = 3) imbedded in a concrete shield have been performed at the Oak Ridge National Laboratory. The facility, NE-213 liquid scintillator detector system, and experimental techniques used to obtain the measured data are described. The two-dimensional discrete ordinates radiation transport codes, calculational models, and nuclear data used in the analysis of the experiments are reviewed.

35799 (PPPL—1702) **Maxwell-Vlasov equations as a continuous Hamiltonian system.** Morrison, P.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 13p. NTIS, PC A02/MF A01.

The well-known Maxwell-Vlasov equations that describe a collisionless plasma are cast into Hamiltonian form. The dynamical variables are the physical although noncanonical variables E, B and f. We present a Poisson bracket which acts on these variables and the energy functional to produce the equations of motion.

35800 (PPPL—1703) **Monte Carlo evaluation of transport coefficients.** Boozer, A.H.; Kuo-Petravic, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1980. Contract AM02-76CH03073. 40p. NTIS, PC A03/MF A01.

A method is developed for evaluating transport coefficients in asymmetric geometries using the Monte Carlo method. The method is applied to the stellarator.

35801 (SAI—254-80-347-LJ) **Bumpy torus transport in the low collision frequency limit.** Hazeltine, R.D.; Catto, P.J. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). May 1980. Contract AC03-76ET53057. 75p. (PRI—5). NTIS, PC A05/MF A01.

A variational formulation of transport for a closed field line, large aspect ratio bumpy torus in the low collision frequency limit is presented. The relatively large radial excursions made by those particles with canceling magnetic and electric poloidal drifts requires generalization of previous neoclassical techniques. General expressions for the transport coefficients of both charge species are given. Explicit numerical coefficients are evaluated under certain simplifying assumptions for both the banana and non-banana species.

35802 (UCID—17530(Rev.1)) **Computational physics program of the National MFE Computer Center.** Mirin, A.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01.

The computational physics group is involved in several areas of fusion research. One main area is the application of multidimensional Fokker-Planck, transport and combined Fokker-Planck/transport codes to both toroidal and mirror devices. Another major area is the investigation of linear and nonlinear resistive magnetohydrodynamics in two and three dimensions, with applications to all types of fusion studies, investigations of more efficient numerical algorithms are being carried out.

35803 **Energy principle with global invariants for toroidal plasmas.** Bhattacharjee, A.; Dewar, R.L.; Monticello, D.A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CHO-3073. *Phys. Rev. Lett.;* **45**: No. 5, 347-350(4 Aug 1980).

A variational principle is proposed for constructing equilibria with low free energy in toroidal plasmas in which relaxation is dominated by a tearing mode of single helicity. States with current density vanishing on the boundary are constructed. Theoretical predictions are compared with experimental data from reversed field pinches and tokamaks.

PLASMA INSTABILITIES

35804 (CONF-800699—4) **Using packaged software for solving two differential equation problems that arise in plasma physics.** Gaffney, P.W. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 50p. NTIS, PC A03/MF A01.

From Elliptic problem solvers conference; Santa Fe, NM, USA (30 Jun 1980).

Experience in using packaged numerical software for solving two related problems that arise in Plasma physics is described. These problems are (i) the solution of the reduced resistive MHD equations and (ii) the solution of the Grad-Shafranov equation.

35805 (ORO—5260-4) **Nonlinear .nagnetohydrodynamics. Progress report, January 1-December 31, 1980.** Vahala, G.; Montgomery, D. (College of William and Mary, Williamsburg, VA (USA)). 1980. Contract AS05-76ET53045. 13p. NTIS, PC A02/MF A01.

Research has centered on two major topics: (1) the statistical determination of equilibrium profiles given only some global information, and (2) higher order growth rate calculations using the Rayleigh-Schroedinger approach.

35806 (SAI—254-80-348-LJ) **Trapped electron modifications to tearing modes in the low collision frequency limit.** Catto, P.J.; Rosenbluth, M.N. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Jul 1980. Contract AC03-76ET53057. 55p. (PRI—6). NTIS, PC A04/MF A01.

In the limit of weak collisions a narrow boundary layer forms at the trapped/untrapped boundary in velocity space. When the electron collision frequency ν/sub e/ is small compared to the wave frequency ω times the inverse aspect ratio ϵ, a realistic collision operator must be employed to evaluate the response of the boundary layer electrons. The parallel current carried by the barely circulating boundary layer electrons results in tearing mode modifications which are evaluated from a slab model in the banana regime (ν/sub e/ $< \epsilon\,\omega$) by using a Lorentz model collision operator.

35807 (SAI—254-80-477-LJ) **Lower-hybrid-drift instability with axis encircling ions.** Myra, J.R.; Catto, P.J.; Aamodt, R.E. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Aug 1980. Contract AC03-76ET53057. 40p. (PRI—11). NTIS, PC A03/MF A01.

The stability of a cylindrical plasma to electrostatic flute perturbations in the ion-cyclotron to lower-hybrid frequency range is considered. The analysis exploits the large growth rates of these modes to reduce the governing radial eigenvalue problem from an integral equation to a second order differential equation, but allows treatment of arbitrary ion Larmor radius to plasma radius. The fastest growing modes of the ion guiding-center-on-axis model are shown to connect onto the lower-hybrid-drift modes of local slab theory. Numerical and analytical results for growth rates and most unstable mode numbers are obtained.

35808 (SAI—254-80-493-LJ) **Strongly-localized ballooning modes in a tandem mirror.** D'Ippolito, D.A.; Myra, J.R. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Aug 1980. Contract AC03-76ET53057. 26p. (PRI—12). NTIS, PC A03/MF A01.

A simple model of a tandem mirror without thermal barriers is employed to study the stability of ballooning modes which are confined to the central mirror cell. The central cell is treated as axisymmetric and long-thin with isotropic pressure, while the end plug is modeled by a stabilizing boundary condition. The scaling of β/sub c/ with the mirror ratio, R, and the connection length, L/sub c/, is computed, and the sensitivity of these results to the magnetic field profile chosen is discussed.

35809 **Stability of high-beta tokamaks to ballooning modes.** Strauss, H.R. (Texas Univ., Austin (USA). Fusion Research Center); Park, W.; Monticello, D.A.; White, R.B.; Jardin, S.C.; Chance, M.S.; Todd, A.M.M.; Glasser, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nucl. Fusion;* **20**: No. 5, 638-642(May 1980).

Fixed-boundary ballooning modes are found to possess a second globally stable regime for high-beta flux-conserving equilibria. This confirms a conjecture of several authors based on local analysis of the instability in the vicinity of the magnetic axis. The range of unstable beta values depends on the details of the equilibrium and, in particular, on shear. Very high shear can decrease the width of the unstable region.

FUSION POWER PLANT TECHNOLOGY

REFER ALSO TO CITATION(S) 34894

35810 (UCRL—84278) **Technology for large tandem mirror experiments.** Thomassen, K.I. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 4 Sep 1980. Contract W-7405-ENG-48. 7p. (CONF-800950—4). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

Construction of a large tandem mirror (MFTF-B) will soon begin at Lawrence Livermore National Laboratory (LLNL). Designed to reach break-even plasma conditions, the facility will significantly advance the physics and technology of magnetic-mirror-based fusion reactors. This paper describes the objectives and the design of the facility.

MAGNET COILS AND FIELDS

35811 (PPPL—1708) **Bow-shaped toroidal magnet coils.** Bonanos, P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 9p. NTIS, PC A02/MF A01.

A constant tension coil in which the structural pathway is of the form of an archer's bow is described. This shape suggests that demountable high field toroidal magnets magnets can be constructed with the joint at the small major radius where it is most useful. The coil tension can be used to maintain the joint in compression and ensure reliable performance.

POWER SUPPLIES, ENERGY STORAGE

35812 (UCRL—84312) **Sustaining neutral beam power supply system for the Mirror Fusion Test Facility.** Eckard, R.D.; Wilson, J.H.; Van Ness, H.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 1980. Contract W-7405-ENG-48. 9p. (CONF-800950—5). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

In late August 1978, a fixed price procurement contract for $25,000,000 was awarded to Aydin Energy Division, Palo Alto, California, for the design, manufacture, installation and acceptance testing of the Lawrence Livermore National Laboratory Mirror Fusion Test Facility (MFTF) Sustaining Neutral Beam Power Supply System (SNBPSS). This system of 24 power supply sets will provide the conditioned power for the 24 neutral beam source modules. Each set will provide the accel potential the arc power, the filament power, and the suppressor power for its associated neutral beam source module. The design and development of the SNBPSS has progressed through the final design phase and is now in production. Testing of the major sub-assembly power supply is proceeding at Aydin and the final acceptance testing of the first two power supplies at LLNL is expected to be completed this year.

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 35812

35813 (DOE/ER—0075) **Neutral beam development plan.** Staten, H.S. (comp.). (Department of Energy, Washington, DC (USA)). Aug 1980. 32p. NTIS, PC A03/MF A01.

The national plan is presented for developing advanced injection systems for use on upgrades of existing experiments, and use on future facilities such as ETF, to be built in the late 1980's or early 90's where power production from magnetic fusion will move closer to a reality. Not only must higher power and longer pulse length systems be developed , but they must operate reliably; they must be a tool for the experimenter, not the experiment itself. Neutral beam systems handle large amounts of energy and as such, they often are as complicated as the plasma physics experiment itself. This presents a significant challenge to the neutral beam developer.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 35271, 35680

35814 (BNL—51134, pp 61-65) **High-current heavy-ion linacs as igniters for commercial-scale inertial-fusion power plants.** Judd, D.L. (Lawrence Berkeley Lab., CA). 1979.

From Linear accelerator conference; Montauk, NY, USA (10 Sep 1979).

This presentation: (1) states the fusion pellet target requirements and the demands they place on heavy-ion linac igniter systems; (2) indicates why high-energy heavy-ion beams are suitable, and why linacs appear capable of meeting the requirements; (3) outlines some of the characteristics of conceptual linac system designs now under study; and (4) describes some of the problems that are not yet solved.

35815 (NRL-MR—4322) **Analysis of proton transport experiments.** Young, F.C.; Sandel, F.L.; Stephanakis, S.J.; Blauner, P.G.; Cooperstein, G.; Goldstein, S.A.; Mosher, D. (Naval Research Lab., Washington, DC (USA)). 5 Sep 1980. Contract AI01-77DP40042. 39p. NTIS, PC A03/MF A01.

Intense 1-MeV proton beams, produced with the GAMBLE II generator at the Naval Research Laboratory, have been transported efficiently over a distance of one meter in a wall-stabilized, current carrying plasma channel. Ion beams from a pinch-reflex-diode were ballistically focused in a neutral-gas background so that a current-neutralized beam was injected into the plasma channel. Channels with diameters of 1.6 cm and 4.5 cm have been studied for gas pressures ranging from 0.1 to 1.5 Torr. Proton currents in the channels were diagnosed with absolutely calibrated prompt-gamma detectors using the $^{19}F(p,\alpha\gamma)^{16}O$ reaction. Temporal measurements are compared with calculated prompt-gamma responses to provide proton energy losses, proton currents and transport efficiencies. For the small diameter channel, poor transport was observed. For the large diameter channel, efficient transport (33% to 100%) was deduced for peak proton currents of $\sim$ 0.3 MA and for energy losses of a few hundred keV.

35816 (NRL-MR—4326) **Vector-potential flow in relativistic beam diodes.** Bacon, D.P.; Goldstein, S.A.; Lee, R.; Cooperstein, G. (Naval Research Lab., Washington, DC (USA)). 5 Sep 1980. Contract AI01-77DP40042. 38p. NTIS, PC A03/MF A01.

Analytic theory, numerical simulations and experiments indicate that a combination of a bias current pinch and an ion induced pinch may allow the efficient pinching of electron beams generated in large aspect ratio diodes. In the new diode geometry, electrons flow radially inward along vector-potential field lines which lie close to the anode. As these electrons do not touch the anode, there is no plasma formation and consequent loss of energy to accelerated ions. Entering a region close to the axis in which an anode plasma does exit, these electrons undergo an ion induced pinch to still smaller radii. Since the bulk of the flow occurs along vector-potential field lines, we have coined this new diode the Paravector-potential diode.

35817 (SAND—80-1701) **Ablative response of microdisc targets irradiated by 1.064 μm light.** Anthes, J.P.; Glibert, K.M.; Palmer, M.A.; Matzen, M.K.; Palmer, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP000789. 35p. NTIS, PC A03/MF A01.

From 6. IEEE International Conference on Plasma Science; Montreal, Quebec, Canada (June 4-6, 1979).

The ablative response of microdisc targets irradiated with an 8 ns FWHM Nd:Glass laser is compared to that of infinite foils. The front surface exhaust velocity, plasma electron temperature, and size of the x-ray emitting region of Al and Fe targets irradiated with a laser intensity of 10^{13} to 10^{14} W/cm^2 are relatively independent of the target diameter and thickness, but the x-ray conversion efficiency (E/sub photon/ $\geqq$ 700 eV) decreases as these target dimensions decrease. These observations suggest that in this experiment: (1) lateral heat flow is not a significant factor: (2) a steady-state ablative flow at the front surface is established; and (3) two-dimensional effects lead to an increase in the density gradient or to a decrease in the average density in the vicinity of the x-ray emitting region as the target dimensions decrease.

35818 (UCRL—83723) **Summary of the status of lasers for inertial confinement fusion.** Holzrichter, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01.

Laser systems designed for plasma research are operating in many laboratories throughout the world. The laser performance itself has become reasonably consistant from laboratory to laboratory and the focusing properties of the laser beams are understood. The plasma physics data, obtained with these systems, also appears to be reasonably self-consistant and is of great interest for inertial fusion applications. These lasers are commonly providing output powers of 0.5 $>$ 2 TW, and power densities on target of 10^{13}-10^{16} W/cm^2, pulse durations on the order of 100 psec to 3 nsec, wavelengths between 0.5 μ and 10 μ, and focal spot sizes of 100 μ or larger where focal spot edge effects are becoming less dominant. In addition, spurious target responses due to such behavior as prepulses, self-focusing, or imprecise focal spot measurement are being observed less often. The technical problems of large multi-beam systems, performing at the 10 TW level, have been overcome and these systems (e.g. the Shiva and Helios lasers) are providing high density compression data with ablative targets. The next step in laser design, the 100 to 300 kJ systems, are under construction and 1 MJ lasers are being contemplated.

35819 (UCRL—84052) **Mechanical technology unique to laser fusion experimental systems.** Hurley, C.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 3 Sep 1980. Contract W-7405-ENG-48. 12p. (CONF-800950—3). NTIS, PC A02/MF A01.

From 11. symposium on fusion technology; Oxford, UK (15 Sep 1980).

Hardware design for laser fusion experimental machines has led to a combination of engineering technologies that are critical to

the successful operation of these machines. These large opto-mechanical systems are dependent on extreme cleanliness, accommodation to efficient maintenance, and high stability. These three technologies are the primary mechanical engineering criteria for laser fusion devices.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 35173, 35194

35820 Development of ductile long-range ordered alloys for fusion reactor systems. Liu, C.T. (Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **85**: No. 86, 907-911(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

A series of iron-base long-range ordered (LRO) alloys with compositions $(Fe,Ni,Co)_3V$ are being developed for fusion reactor applications. The alloys form a cubic ordered structure similar to $AuCu_3$ below their critical ordering temperature. The alloys in the ordered state are ductile, with tensile elongation in excess of 35% at room temperature. Tensile tests of the ordered alloys at elevated temperatures indicate an unusually attractive mechanical behavior. Their strength, instead of decreasing as with conventional alloys, increases with temperature because of ordering. As a result, the ordered alloys are much stronger than type 316 stainless steel, particularly at elevated temperatures. The ordered alloys also exhibit excellent creep strength; their creep rate is lower than that of type 316 stainless steel by 3 orders of magnitude at 650°C. A combination of excellent strength and adequate ductility makes the iron-base LRO alloys uniquely attractive for high-temperature structural applications.

35821 (GA-A—15953) **Radiation shielding design considerations for Doublet III.** Engholm, B.A. (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76ET51011. 82p. (CONF-800607—86). NTIS, PC A05/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Calculations and measurements were made of the bremsstrahlung (x-ray) doses resulting from runaway electron shots at Doublet III. The analysis considered direct, wall-scattered, and skyshine contributions. Reasonably good agreement was obtained between calculations and measurements. The x-ray dose in the control room was about 1 mR per runaway shot, while that at the north boundary was undetectable, with a calculated value of 0.05 mR per shot. These low doses attest to the adequacy of the 2 ft concrete shadow shield surrounding the Doublet III room. Exploratory shielding analyses were performed for possible neutron generation if Doublet III were operated with neutral beam injection in an aggressive D-D mode.

35822 (HEDL-SA—2165-FP) **Startup of Experimental Lithium System.** McCauley, D.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1980. Contract AC14-76FF02170. 31p. (CONF-800814—16). NTIS, PC A03/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; Las Vegas, NV, USA (24 Aug 1980).

The Experimental Lithium System (ELS) is designed for full-scale testing of targets and other lithium system components for the Fusion Materials Irradiation Test (FMIT) Facility. The system also serves as a test bed for development of lithium purification and characterization equipment, provides experience in operation of large lithium systems, and helps guide FMIT design.

35823 Development of high-quality titanium—tritide targets for the rotating-target neutron source. Jones, L.M.; Makowiecki, D.M.; Steward, S.A. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). W-7405-ENG-48. *J. Vac. Sci. Technol.;* **17**: No. 5, 1225-1232(Sep 1980).

The Rotating-Target Neutron Source II (RTNS II) at Lawrence Livermore Laboratory (LLL) is the most intense continuous source of 14-MeV D-T neutrons currently available and is a national center for the study of the effects of these neutrons on materials of interest to the fusion community. The 14-MeV neutrons are produced when a 400-keV deuteron beam strikes an approximately 10-μm-thick titanium—tritide layer that adheres to a dish-shaped water-cooled copper-alloy substrate, rotating at 5000 rpm. The lifetimes and average neutron source strengths of the targets used during routine operation on the older and less powerful RTNS I and during early operation on RTNS II have varied widely, and several targets have performed below minimum standards. A study at LLL for improving the reliability of each target and increasing the average neutron source strength and lifetime has been successfully completed. Four 20-cm-diam. targets were produced. The first was used on RTNS I for over 200 h, more than twice the previous average, and the neutron source strength was increased 6%. The three other targets were tested on RTNS II and were compared with three standard production targets. The greater average neutron source strength of the LLL targets was statistically significant. We attribute this success to the production of high-quality titanium—tritide layers. Materials characterization and the titanium evaporation and tritium reaction systems are described, as well as special production techniques.

35824 Hydrogen profiles in tokamak fusion reactor first walls. Look, G.W.; Baskes, M.I. (Sandia Labs., Albuquerque, NM (USA)). *J. Nucl. Mater.;* **85**: No. 86, 995-999(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Calculations have been performed to predict the hydrogen isotope profiles in the first wall of proposed fusion reactors. These profiles are obtained from numerical diffusion calculations which include D-T implant, H production through the (n,p) reaction, and thermal cycling of the wall. It is shown that the use of titanium as a first wall material can lead to staedy-state hydrogen isotope concentraions greater than 1000 appm under proposed EPR and NUWMAK operating conditions. Calculations for stainless steel, under the same operating conditions, show hydrogen isotope concentrations of less than 20 appm. Thus, retained hydrogen and the possibility of structural degradation due to hydrogen embrittlement should be important considerations in selection of first wall materials.

35825 Desorption of TiD_2 films formed during simulated tokamak gettering cycles. Malinowski, M.E. (Sandia Labs., Livermore, CA (USA)). *J. Nucl. Mater.;* **85**: No. 86, 957-962(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

The desorptions of titanium deutero-tritide films formed during TFTR (Tokamak Fusion Test Reactor) operation were simulated by the decompositions of essentially clean titanium deuteride films at 523 K. A simulated desorption cycle consisted of the deposition of a 0.09 μm film followed by deuteriding and isothermal desorption. This thickness film would correspond to that anticipated after approx. 30 discharge/gettering cycles in TFTR. Two series of experiments were run: In one, the deposition/desorption cycle was repeated four times with fully deuterided films, resulting in the formation and desorption of films between 0.09 μm to 0.36 μm thick. In the second series, partially deuterided films between 0.09 μm to 0.72 μm thick were deposited and desorbed. All the observed data were in agreement with a simple model which predicted the desorption rates to be determined solely by the average film D/Ti ratios: The results showed that rapid decomposition occured between D/Ti ratios of $2 \rightarrow 1.5$ followed by a constant, lower desorption rate between D/Ti ratios of 1.5 to 0.1. This rate, which was independent of film thickness, was approx. $2.2 \times 10^{15} D_2$ molecules $mm^{-2} s^{-1}$. At D/Ti ratios <.1, the rate decreased to near zero at D/Ti approx. 0. The data indicate that desorption of essentially clean, radiation damage-free films as thick as 1.2 μm could occur in < approx. 4×10^4 s at 523 K.

35826 Low Z coatings for fusion reactor applications. Mattox, D.M.; Mullendore, A.W.; Pierson, H.O.; Sharp, D.J. (Sandia Labs., Albuquerque, NM (USA)). *J. Nucl. Mater.;* **85**: No. 86, 1127-1131(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

A large number of potential coating and substrate materials for tokamak fusion reactor components have been evaluated as to their erosion rates under low energy (250-1000 eV) hydrogen ion bombardment. For further testing, promising candidate coating materilas have been deposited by chemical vapor deposition (TiB_2, TiC and B_4C) and plasma spraying (Be, TiB_2, TiC and VBe_{12}) onto metal and graphite substrates. The adherence of the coatings has been evaluated in pulsed electron beam heating experiments. A number of coating-substrate combinations have survived 30-50 one second pulses of heating at power densities of 2 kW/cm^2 without apparent damage. Others fail by thermal stress induced spall, coating-substrate alloying reactions and/or substrate melt.

35827 General mechanism for helium blistering involving displaced atom transport. McDonnell, W.R. (Savannah River Ecology Lab., Aiken, SC (USA)). *J. Nucl. Mater.;* **85**: No. 86, 1117-1121(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

A mechanism developed to account for formation of vertically elongated blisters in high displacement environments produced by ^{252}Cf alpha particles and fission fragments has been extended to formation of dome-shaped blisters in the low displacement environments produced by simple helium ion beams. In this mechanism, transport of displaced atoms to relieve compressive stresses in the helium-implanted layer allows interconnections of small, subsurface bubbles to form the blister cavity. The same transport may cause thickening of the blister caps at low implantation energies. The transition from dome-shaped to vertically elongated blistering occurs

between the 300 and 3000 displacements per helium atom produced by simple helium ions and ^{252}Cf radiations, respectively.

35828 Simulation of first wall damage: Effects of the method of gas implantation. Packan, N.H.; Farrell, K. (Oak Ridge National Lab., TN (USA)). *J. Nucl. Mater.;* **85**: No. 86, 677-681(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Cavity formation in an austenitic alloy related to type 316 stainless steel has been explored with regard to various methods of gas implantation. Irradiations were conducted at 900 K to doses of 1, 10, and 70 dpa with helium injection levels of 20 at. ppm/dpa. Highest swelling (18%) was exhibited by the unimplanted reference material; a lesser amount by simultaneous helium injection (11%). Greatly reduced swelling due to profuse cavity nucleation was the result of the preinjection of 1400 at. ppm He, either at room temperature (S = 1%) or at 900 K (4%). The dislocation density was not sensitive to the helium injection technique; however, the evolution of the dislocation structure from faulted loops to network was retarded for the case of RT-preinjection compared with the alternate techniques. Simultaneous injection of 50 at. ppm H/dpa, along with the helium, may have caused a modest increase in the cavity and dislocation concentrations at higher doses.

35829 Deuterium profiles in titanium and alloys. Pontau, A.E.; Haggmark, L.G.; Wilson, K.L.; Bastasz, R.; Malinowski, M.E.; Dawson, D.B.; Bauer, W. (Sandia Labs., Albuquerque, NM (USA)). *J. Nucl. Mater.;* **85**: No. 86, 1013-1017(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Deuterium concentration profiles in Ti, Ti-6Al, and Ti-6Al-4V have been investigated after 10 keV D^+s implantation at room temperature. Profiles were determined using the $D(^3He,\alpha)p$ nuclear reaction and also by secondary ion mass spectrometry (SIMS). The amount of retained D in the near-surface region (approx. 5 μm) was monitored as a function of time and was found to be strongly microstructure dependent. Annealed Ti retained the most D while the Ti-6Al-4V alloy retained the least D in this region. The D remained in the bulk of the sample during implant and subsequent aging at room temperature.

35830 Effect of pulsed HVEM irradiation on microstructure evolution in a simple Fe-Ni-Cr alloy. Powell, R.W. (Hanford Engineering Development Lab., Richland, WA (USA)); Odette, G.R. (California Univ., Santa Barbara (USA)). *J. Nucl. Mater.;* **85**: No. 86, 695-699(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

The effect of pulsed electron irradiation on microstructure evolution was studied in a simple Fe-Ni-Cr alloy and the results compared with a theoretical model. Pulse periods of 2.5 to 60 seconds (duty factor near 50%) at 600°C significantly reduced the maximum swelling rate compared to continuous irradiation. The void concentration was observed to increase and void size and swelling rates to decrease for the pulsed cases compared to the steady irradiation. Preliminary model calculations were used to guide the experiments and in the qualitative interpretation of the results. While there are several areas of agreement with experiment, the results indicate that further development of the models is required.

35831 Radiation-induced solute segregation in a V-15 Wt.% Cr alloy. Rehn, L.E.; Agarwal, S.C.; Nolfi, F.V. Jr. (Argonne National Lab., IL (USA)). *J. Nucl. Mater.;* **85**: No. 86, 763-767(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Measurements of the dose and temperature dependences of radiation-induced segregation in a V-ion irradiated alloy of V-15 Cr are reported. Very rapid migration of Cr atoms toward the external surface occurs during irradiation in the temperature range from approx. 450°C to 700°C. A maximum in the degree of segregation is found near 650°C for a peak dose rate of approx. 3×10^{-3} dpa s^{-1}.

35832 Stability and regeneration of low-Z coatings during elevated temperature irradiation. Rehn, L.E.; Okamoto, P.R.; Potter, D.I.; Wiedersich, H. (Argonne National Lab., IL (USA)). *J. Nucl. Mater.;* **85**: No. 86, 1139-1143(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

The formation and stability of coatings of Ni_3Si on the external surfaces of Ni-6 at.% Si specimens has been studied in-situ by infrared pyrometry during irradiation at elevated temperatures. The temperature dependence of the radiation-induced growth of the coatings is shown to be dose rate dependent. The results indicate that radiation-induced segregation can be used to maintain the integrity of appropriate coatings. The design of self-healing coatings appears possible utilizing radiation-induced segregation.

35833 Sputtering of Be and BeO by light ions. Roth, J.; Bohdansky, J.; Blewer, R.S.; Ottenberger, W. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Borders, J. (Sandia Labs., Albuquerque, NM (USA)). *J. Nucl. Mater.;* **85**: No. 86, 1077-1079(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Sputtering yields of Be and BeO using 50 eV to 8 keV H^+, D^+ and He^+ ions are reported. The measurements were made by determining the weight loss of the samples using a microbalance with submicrogram sensitivity. Zone melted Be and sintered BeO targets were used. For the oxide measurements, the surface charge was compensated by electrons emitted from a hot tungsten filament. The energy dependence of the sputtering yield for both Be and BeO shows a maximum near 1 keV and a sharp decrease to lower energies. The results are discussed in terms of a scaling rule for low energy ion sputtering developed recently.

35834 Helium gas bubble formation in binary and ternary alloys of vanadium irradiated by energetic Ni^{++} ions. Schneider, J.G.; Chen, C.W. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Materials Science and Engineering). *J. Nucl. Mater.;* **85**: No. 86, 745-749(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Simulation experiments involving He implantation and 4 MeV Ni^{++} ion irradiation were conducted on three binary alloys of V with 5, 10 and 20% Ti and their ternary alloys with Be or Zr up to 1%. All irradiated alloys display He bubbles of varying sizes and densities. The effect of the three solutes, Ti, Be and Zr, on bubble formation is to promote nonuniform distribution of bubbles through second phase precipitates. The mechanism leading to, and the consequence of, close association of bubbles with the precipitates are discussed.

35835 Microstructures developed in 'simulated' fusion irradiations. Spitznagel, J.A. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)); Wiffen, F.W. (Oak Ridge National Lab., TN (USA)); Nolfi, F.V. (Argonne National Lab., IL (USA)). *J. Nucl. Mater.;* **85**: No. 86, 629-646(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Microstructural information is reviewed for irradiation conditions which 'simulate' one or more salient features of the irradiation environment anticipated at first wall and blanket positions in a fusion reactor. The effects of high energy neutron damage from T[d,n], Be[d,n] and 16 MeV proton irradiations, and the effects of simultaneous atom displacement damage and helium and hydrogen production from mixed-spectrum fission reactor and dual-ion irradiation experiments are summarized for a variety of metals. It is shown that observations of microstructural sensitivity to damage rate, irradiation temperature and helium are providing important clues for developing damage resistant structural alloys for fusion reactor applications.

35836 Cyclic deformation of refractory metals for first wall application. Stoloff, N.S. (Rensselaer Polytechnic Inst., Troy, NY (USA)). *J. Nucl. Mater.;* **85**: No. 86, 855-859(Dec 1979).

From 1. topical meeting on fusion reactor materials; Miami Beach, FL (29 - 31 Jan 1979).

Tests to determine the effects of frequency, test temperature, and hydrogen content on the fatigue life and crack propagation behavior of polycrystalline vanadium and niobium are described. Unalloyed vanadium and niobium are nearly insensitive to test frequency at 25°C, while hydrided alloys exhibit a strong frequency effect. Increasing test temperature decreases fatigue life, consistent with decreasing tensile strength. A brief survey of irradiation effects on fatigue of refractory metal alloys suggests that fatigue resistance of irradiated niobium and vanadium should increase in proportion to effects on strength.

GENERAL AND MISCELLANEOUS

REFER ALSO TO CITATION(S) 35016

MANAGEMENT

REFER ALSO TO CITATION(S) 35840

35837 (DOE/CR—0020) **Debt collection project report.** (Department of Energy, Washington, DC (USA)). May 1980. 75p. NTIS, PC A04/MF A01.

In October 1979 the Office of Management and Budget initiated a review of debt collection within the Federal Government. A DOE Debt Collection Project Team was established, and seven

activites were selected for review. These were Albuquerque Operations Office; Bonneville Power Administration; Chicago Operations and Regional Office; Naval Petroleum Reserves, California; Oak Ridge Operations Office; Washington Financial Services Division; and Western Area Power Administration. The team visited each of these activities to collect data on the size, age, and types of receivables managed and procedures for billing, aging, and handling overdue accounts. Various deficiencies were found to exist at several of the DOE entities that are not consistent with good management practices in the performance of their debt collection functions. Also, the Debt Collection Project Team identified a wide variation in the procedures followed by DOE activities in the management of accounts receivable, and a wide variation in the effectiveness of the debt management functions. 1 figure, 17 tables. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 34584

35838 (ANL—80-75) **Automatic transformations in the inference process.** Veroff, R.L. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 71p. NTIS, PC A04/MF A01.

A technique for incorporating automatic transformations into processes such as the application of inference rules, subsumption, and demodulation provides a mechanism for improving search strategies for theorem proving problems arising from the field of program verification. The incorporation of automatic transformations into the inference process can alter the search space for a given problem, and is particularly useful for problems having broad rather than deep proofs. The technique can also be used to permit the generation of inferences that might otherwise be blocked and to build some commutativity or associativity into the unification process. Appropriate choice of transformations, and new literal clashing and unification algorithms for applying them, showed significant improvement on several real problems according to several distinct criteria. 22 references, 1 figure.

35839 (BDX—613-2484) **Quadric solids and computational geometry.** Emery, J.D. (Bendix Corp., Kansas City, MO (USA)). 25 Jul 1980. Contract AC04-76DP00613. 66p. NTIS, PC A04/MF A01.

As part of the CAD-CAM development project, this report discusses the mathematics underlying the program QUADRIC, which does computations on objects modeled as Boolean combinations of quadric half-spaces. Topics considered include projective space, quadric surfaces, polars, affine transformations, the construction of solids, shaded image, the inertia tensor, moments, volume, surface integrals, Monte Carlo integration, and stratified sampling. 1 figure.

35840 (CONF-8005103—(Summ.)) **AESOP XXI: summary of proceedings.** (Department of Energy, Washington, DC (USA). Office of Computer Services and Telecommunications Management). Aug 1980. 86p. NTIS, PC A05/MF A01.

From 21. AESOP conference; Cincinnatti, OH, USA (20 May 1980).

The theme of the May 1980 meeting of the Association for Energy Systems, Operations, and Programming (AESOP) was Information Exchange With An Emphasis on Management. Session I, the AESOP Washington Report, involved organizational, personnel, and structural changes to the Department of Energy since its inception in 1977, ADP management and changes in Federal ADP activity, and progress in telecommunications through legislative and technological change. Session II consisted of three management discussion sessions: the national laboratories group discussed available options for changing from leasing to owning computer facilities, costs of conversion, and effects of the Service Contract Act, the educational institutions and laboratories group discussed management and organizational structure for distributed computing, the relationship of ADP to word processing, and the development of security plans as described in DOE Order 1360.2, A Computer Security Program for Unclassified Computer Systems, the production facilities group exchanged views on the implementation of DOE Order 1360.2 and experiences with distributed data processing. Session II described methods for improving productivity of computer systems. Sessions IV addressed the issue of ADP management and the development and implementation of various computer systems. Session V described recent trends in networking, results of computer performance evaluation group meetings, and teleconferencing and electronic mail. Session VI provided more information concerning DOE Order 1360.2; security, propriety, sensitivity, and privacy were discussed.

35841 (COO—2383-0073) **Implementation of a hidden line and surface algorithm.** Schweitzer, M.L. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Aug 1980. Contract AS02-76ER02383. 58p. (UIUCDCS-R—80-1015; UILU-ENG—80-1723). NTIS, PC A04/MF A01.

The implementation of a 3-dimensional hidden line and surface algorithm discussed by Hamlin and Gear [NASA Langley Research Report 77-1] is described, and its advantages and disadvantages are examined. This algorithm is organized so that data can be preprocessed to speed display computations and so that the display is generated in a form suitable for a raster scan, refresh display. The version of the program described here is a hidden-line program, but the underlying algorithm is the same for both. 11 figures, 3 tables.

35842 (LA-UR—79-3294) **Fortran for the 1980's.** Adams, J.; Brainerd, W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 25p. (CONF-801001—2; CONF-801012—2). NTIS, PC A02/MF A01.

From International federation for information processing congress; Tokyo, Japan (6 Oct 1980).

The new standard Fortran 77 has not been available long, but the American National Standards Institute (ANSI) committee X3J3 responsible for Fortran standardization is already working on the next revision. Since the result of this work will be a candidate for an international (ISO) standard, it is important that work being done now become known to all persons interested in Fortran. A new set of problems related to the accommodation of related standards in data base management and real-time process control, as well as the ever-increasing size of the language, have caused the standardization committee to consider some new approaches to the development of the next standard. These new approaches and many of the new features that probably will be in the next Fortran standard are described. It is hoped that this presentation will stimulate comments and suggestions in time to include them before work on the next standard is completed. 2 figures.

35843 (LBL—9097) **Role of the microcomputer in the demise of western civilization.** Stevens, D.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1979. Contract W-7405-ENG-48. 18p. (CONF-801001—1; CONF-801012—1). NTIS, PC A02/MF A01.

From International federation for information processing congress; Tokyo, Japan (6 Oct 1980).

Every revolutionary new technology has been accompanied by a host of Cassandras prophesying the end of the world as it is known. Unlike Cassandra, heretofore they have all been wrong. The microcomputer has come into its own as a revolutionary new technology, and the new generation of Cassandras is beginning to appear. They, too, for the most part are wrong, but their error is not in their conclusion - for the microcomputer will bring about the end of Western Civilization - but in their concentration on technological consequences. It is rather a social consequence, the willful disintegration of society, which will be the motivating force. But Cassandra's tragedy was that no one listened to her.

35844 (LBL—9538) **Some cautionary aphorisms for user-oriented computer management.** Stevens, D.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. 21p. (CONF-801001—3; CONF-801012—3). NTIS, PC A02/MF A01.

From International federation for information processing congress; Tokyo, Japan (6 Oct 1980).

One sign of the approaching maturity of the computing craft is a growing awareness of the importance of the users. A consequence of this awareness is the growing interest in the development of user-oriented, rather than system- or center-oriented, computer management. This note is directed to those who have some experience in the latter and wish to make the switch to the former. It attempts to highlight those aspects of user-oriented management most likely to frustrate the experienced center-oriented manager. This is not a guidebook to success, but rather a sort of psychological comforter. It is written in humorous style; e.g., nobody reads the manual to PREVENT errors. (RWR)

35845 (LBL—9881) **Software standards in chemistry.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 191p. (CONF-790779—). NTIS, PC A09/MF A01.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

The National Resource for Computation in Chemistry (NRCC) was established as a division of Lawrence Berkeley Laboratory in October 1977. Its functions are to make information on existing and developing computational methodologies available to all segments of the chemistry community, to make state-of-the-art computational facilities (both hardware and software) accessible to the chemistry community, and to foster research and development of new computational methods for application to chemical problems. The goal of this conference was to discuss and recommend standards for machine-independent, modular, and well-documented software suitable for use on large minicomputers. The conference began with a plenary session comprising talks of general interest on various aspects of portability and standardization. After the general session, the participants divided into several smaller working groups in order

to discuss portability considerations and standards, documentation and coding standards, machine specification, quantum chemistry software base, quantum chemistry data interfaces, small molecule crystallography, and large molecule crystallography. The present volume consists of the edited summaries of the invited talks, final reports of the working groups, and reports generated by subcommittees of the working groups. Separate abstracts were prepared for the ten talks given in this volume. (RWR)

35846 (LBL—9881, pp 1-5) **Robust mathematical software.** Moler, C.B. (Univ. of New Mexico, Albuquerque). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

This note covers two topics very briefly: the LINPACK and EISPACK matrix software packages, and machine-dependent constants in numerical calculations. LINPACK is a collection of FORTRAN subroutines for analyzing and solving various types of simultaneous linear equations. EISPACK is a collection of FORTRAN subroutines for solving various matrix eigenvalue problems. (RWR)

35847 (LBL—9881, pp 6-21) **Structured programming in the FORTRAN environment using the SFTRAN3 preprocessor.** Lawson, C.L. (Jet Propulsion Lab., Pasadena, CA). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

Structured programing is described and some examples are given. Characteristics of the SFTRAN3 preprocessor are listed. This item consists of a series of viewgraphs; there is no text. (RWR)

35848 (LBL—9881, pp 22-25) **Programming aids: philosophy and tools.** Schryer, N.L. (Bell Labs., Murray Hill, NJ). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

Rules of programing that can be mechanically verified by existing software tools are discussed. Aspects forming a successful programing methodology include portability, good programing languages, easier debugging, program testing, and efficiency. Tools to support these aspects are mentioned. (RWR)

35849 (LBL—9881, pp 27-38) **External standard data structures for computation in chemistry.** Diercksen, G.H.F.; Kraemer, W.P. (Max Planck Institut fur Physik und Astrophysik, Munchen, West Germany). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

External Standard Data Structures and I/O interface service functions are described as a programing tool to pass data between different programs. The objective for the design of external standard data structures has been to guarantee a maximum mutual independence of the individual programs. The objective for the design of the I/O interface has been to guarantee a maximum independence of the user programs from the system I/O functions. The external data structures and I/O service functions described have been in use for many years in the MUNICH Molecular Program System. They have been found flexible, open-ended, and easy and convenient to use and implement in a higher-level programing language. 2 figures, 1 table.

35850 (LBL—9881, pp 39-48) **Portable software with emphasis on crystallography.** Stewart, J.M. (Univ. of Maryland, College Park). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

Experiences with and proposed methods of preparing transportable software are discussed. A new system, XTAL, has been defined for crystallographic programing; the coding is being done in RATMAC, a FORTRAN-based preprocessor. Use of MACROS as an aid to portability is emphasized. (RWR)

35851 (LBL—9881, pp 81-105) **Roster of software tools.** Beebe, N.H.F. (Univ. of Utah, Salt Lake City). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

A number of software tools are briefly described. The tools fall into several categories: preprocessors and other coding aids, mathematics routines (matrices, linear equations), programing languages, and typesetting systems. The various tools discussed are as follows: FLECS, RATFOR, SFTRAN/3, SPARKS, the PFORT verifer, DAVE, STRUCT, FORSTA, EDIT, macro processors, module cross reference utilities, DOCUMENT, FMFOR, YACC; basic linear algebra subroutines (the BLAS), PORT library framework, EISPACK/2, LINPACK, MATLAB; the PASCAL users' group, symbolic and algebraic manipulation languages; and TEX and METAFONT. (RWR)

35852 (LBL—9881, pp 106-115) **Proposal for a standard set of primitives for machine-independent bit manipulation in FORTRAN.** Beebe, N.H.F. (Univ. of Utah, Salt Lake City). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

Several criticisms are leveled at the Instrument Society of America standard on bit primitives S61.1, Industrial Computer System FORTRAN Procedures for Executive Functions, Process Input/Output, and Bit Manipulation. Then an alternative set of standard bit manipulation routines is proposed that remedies all of the criticisms. (RWR)

35853 (LBL—9881, pp 116-128) **Proposal for a standard set of primitives for machine-independent character manipulation in FORTRAN.** Beebe, N.H.F. (Univ. of Utah, Salt Lake City). 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

After some background information on the need for a good, standard set of primitives for machine-independent character manipulation and criteria for satisfactory support of character data, the various character primitives proposed are described in detail. (RWR)

35854 (LBL—9881, pp 129-150) **Outline for a machine-independent random-access input/output interface.** Beebe, N.H.F.; Binkley, J.S.; Duchamp, D.J.; Elbert, S.T.; McLean, A.D.; Purvis, G.D. III; Raffenetti, R.C. 1979.

From Software standards in chemistry conference; Salt Lake City, UT, USA (25 Jul 1979).

A proposed set of FORTRAN-callable routines that implement a standard machine-independent interface for random-access I/O is presented. Although the internal structure of the interface routines will vary from machine to machine, the calling sequences will be constant, and devoid of machine-specific parameters. Actual implementations of the interface routines will be provided to the NRCC and the Quantum Chemistry Program Exchange by members of the Working Group Subcommittee for those host operating systems to which they have access. It is hoped that other members of the computational community will be similarly willing to provide implementations developed for different computer systems.

35855 (SAND—80-1051C) **Teaching old Fortran programmers new tricks.** Wampler, B.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 18p. (CONF-801018—1). NTIS, PC A02/MF A01.

From COMPSAC 80; Chicago, IL, USA (28 Oct 1980).

For a number of valid reasons, Fortran remains in widespread use. It can be difficult to get long-time Fortran programmers to accept the use of new software tools that are increasingly required to lower software costs. In order to gain acceptance for a new software tool, it is necessary for it to be easy to learn and use, as well as to provide new benefits. In the process of introducing the use of the Ratfor preprocessor for Fortran, a number of useful guidelines were defined for gaining the acceptance of any new software tool in an existing environment.

35856 (SAND—80-1498) **CDC 6600/7600 subroutine for Bessel functions Y/sub ν/(x), $x > 0$, $\nu \geq 0$.** Amos, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 17p. NTIS, PC A02/MF A01.

Formulas for Y/sub ν/(x) and Y/sub $\nu+1$/(x) are implemented on intervals $0 < x \leq 3$, $3 < x < 20$, $x \geq 20$ and $-1/2 \leq \nu < 1/2$ to start forward recursion for N member sequences Y/sub $\nu+k-1$/(x), $k = 1,...,N$. A recursive form of the power series is used on $0 < x \leq 3$, while the backward recursive Miller algorithm applied to a confluent hypergeometric representation is implemented on $3 < x < 20$. For $x \geq 20$, Y/sub ν/(x) and Y/sub $\nu+1$/(x) are computed from the asymptotic expansion for $x \to \infty$. If the initial order ν is larger than NULIM, the sequence is started by using the uniform asymptotic expansion for $\nu \to \infty$. Here NULIM = 70 if N = 1 or NULIM = 100 if $N > 1$. Overflow tests are made on the leading term of the uniform asymptotic expansion for large orders and small x.

35857 (UCID—18743) **SEAS: a state estimation algorithm for small-scale systems.** Azevedo, S.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jul 1980. Contract W-7405-ENG-48. 113p. NTIS, PC A06/MF A01.

The computer code SEAS (State Estimation Algorithm for Small-Scale Systems), written in FORTRAN IV, is discussed. SEAS is a first-generation program developed at the Lawrence Livermore National Laboratory to calculate state estimates of a linear dynamic system from noisy measurement data. The SEAS code is available on both PDP11/70 and CDC-7600 computers. A formatted output data file is generated for a plotter/post-processor. This post-processor file contains the state estimates and other filter-generated quantities. SEAS is a compact implementation of a sophisticated on-line state estimation algorithm: a computationally stable version of the linear Kalman filter for small word-length computers. The program is modular in design to facilitate straight-forward interfacing with user-supplied subroutines. This user's manual describes the algorithm, program structure, operation, special features, and the various problems that SEAS can solve. SEAS is applied to a simple linear example, and graphical outputs are presented. The program is easily adaptable to solve estimation problems involving multiple-input and/or multiple-output systems of varying dimension. The case of corre-

lated process or measurement noise statistics can also be solved. A linear system simulation code (SEASIM) was developed concurrently on the CDC-7600 to provide input for SEAS. In addition, a stabilized linear Kalman filter program (SEALKF) was also developed for testing SEAS output. These have both become excellent design tools and are described in appendices. 16 figures, 5 tables.

35858 Nonexistence of extended Gauss-Laguerre and Gauss-Hermite quadrature rules with positive weights. Kahaner, D.K. (Los Alamos Scientific Lab., NM); Monegato, G. Contract W-7405-ENG-36. *Z. Angew. Math. Phys.;* **29**: 983-986(1978).

A simple necessary condition on the nodes is ued to establish that extended Gauss-Laguerre and Gauss-Hermite quadrature formulas (Kronrod type) do not exist with positive weights when $n > 0$ in the Laguerre case and $n = 3$ or $n > 4$ in the Hermite case.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 35019, 35425, 35774

35859 (LBL—10618) **Intelligent support system for energy resources in the United States.** Rosenberg, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1980. Contract W-7405-ENG-48. 11p. (CONF-801008—2). NTIS, PC A02/MF A01.

From 43. annual meeting of the American Society for Information Sciences; Anaheim, CA, USA (5 Oct 1980).

A frames-based system for reasoning in a petroleum resources domain is described. By extending the notion of frames to include rule frames, which can then be interpreted and applied, expertise of various kinds can be directly encoded into the frame representation. Frame-based rules are useful in encoding constraints, performing actions, noticing complex situations, and deducing solutions. By varying the interpretation of a rule frame, the same competence knowledge can be used in performing each of these tasks. Rules are able to use the frame-based representation in finding other rules, and avoiding most pattern-directed invocation. 4 figures.

35860 (SAND—80-0272C) **Numerical expression of general relationships in hierarchical data base management systems.** Hall, R.C. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 27p. (CONF-801009—1). NTIS, PC A03/MF A01.

From 6. international conference on very large data bases; Montreal, Canada (1 Oct 1980).

The need for a means to express general relationships among entity occurrences in hierarchical data bases is addressed. Integer expression of general path segments is described as a means to meet this need. Operations on the expressions are also described. Two possible implementations are discussed. Both implementations are compatible with the hierarchical data model, and provide a logical extension that permits representation of many-to-many relationships. 4 figures.

35861 Analytical look at chemical publications. Braun, T. (L. Eoetvos Univ., Budapest, Hungary); Bujdoso, E.; Lyon, W.S. Contract W-7405-ENG-26. *Anal. Chem.;* **52**: No. 6, 617A-618A, 620A, 622A, 624A, 626A, 629A(May 1980).

This report describes some of the results concerning distribution of papers by country, national growth rates, distribution of papers among various journals, and publication times in several analytical journals. Publication in analytical chemistry is a dynamically growing field, with a doubling time of about 14 years, dominated by the USSR and the US, with about 12 core journals, and having a publication time (receipt of manuscript to print) of about six months. Analytical chemistry makes up about 8% of the total chemistry literature and apparently will continue to hold that share in the future. 7 figures, 9 tables. (DP)

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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010098	5:35006	Price to members, $110.00
010099	5:35007	Price to members PC, $110.00
010100	5:35008	Price to members, $110.00
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CONF-7703137-	(Computer based conference, Upton, NY, USA, 4-28 Mar 1977)	
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CONF-7709210-	(DOE workshop on geothermal resources assessment and reservoir engineering, Larderello, Italy, 12-16 Sep 1977)	
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CONF-7710236-	(29. Canadian conference on coal, Edmonton, Alberta, Canada, 2-4 Oct 1977)	
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CONF-7805201-	(43. American Petroleum Institute midyear meeting, Toronto, Canada, 8-11 May 1978)	
	5:34544	Washington, DC; American Petroleum Institute (1978).
CONF-7808126-	(Annual meeting North Atlantic region of the American Society of Agricultural Engineers, Amherst, MA, USA, 6-9 Aug 1978)	
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CONF-7811174-	(US DOE environmental control symposium, Argonne, IL, USA, 28-30 Nov 1978)	
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CONF-781238-	(Winter meeting for American Society of Agricultural Engineers, Chicago, IL, USA, 18-20 Dec 1978)	
3	5:35093	St. Joseph, MI; American Society of Agricultural Engineers (1978).
CONF-790334-	(Oil shale symposium, Denver, CO, USA, 26-28 Mar 1979)	
13	5:34581	*See* PNL-SA-7579
CONF-7903137-	(International gas turbine conference, San Diego, CA, USA, 12-13 Mar 1979)	
1	5:34656	NTIS, PC A02/MF A01
CONF-7904114-	(Study of an electron-proton facility for Europe, Hamburg, F.R. Germany, 2-3 Apr 1979)	
	5:35354	*See* DESY-79/48
CONF-7904144-	(Summer meeting of the Institute of Electrical and Electronics Engineers, New York, NY, USA, 24-26 Apr 1980)	
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CONF-7904148-	(Conference on passive collection of solar energy in buildings, London, UK, 24 Apr 1979)	
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CONF-7905163-	(44. American Petroleum Institute refining department midyear meeting, San Francisco, CA, USA, 14-17 May 1979)	
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(Vol.2)	5:35685	*See* LBL-9501(Vol.2)
CONF-790770-	(Management assessment of peat as an energy resource meeting, Arlington, VA, USA, 22-24 Jul 1979)	
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CONF-790779-	(Software standards in chemistry conference, Salt Lake City, UT, USA, 25-27 Jul 1979)	
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	5:35850	*See* LBL-9881
	5:35851	*See* LBL-9881
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	5:35853	*See* LBL-9881
	5:35854	*See* LBL-9881
CONF-790789-	(UK section International Solar Energy Society meeting, London, UK, 3 Jul 1979)	
1	5:34651	NTIS, PC A02/MF A01
CONF-790885-	(9. international symposium on lepton and photon interactions at high energy, Batavia, IL, USA, 23-29 Aug 1979)	
18	5:35703	*See* FERMILAB-CONF-79/79-EXP
19	5:35704	*See* FERMILAB-CONF-79/80-EXP
20	5:35696	*See* FERMILAB-CONF-79/85-EXP
CONF-790893-	(8. international mass spectrometry conference, Oslo, Norway, 11-18 Aug 1979)	
3	5:35259	*See* PNL-SA-7912
CONF-7908122-	(Solar Energy Industries Association meeting, San Jose, CA, USA, 9 Aug 1979)	
1	5:34681	*See* SERI/SP-733-526
CONF-790910-	(Symposium on calculation of phase diagrams and thermochemistry, Milwaukee, WI, USA, 17-19 Sep 1979)	
6	5:35152	NTIS, PC A03/MF A01
CONF-790927-	(Linear accelerator conference, Montauk, NY, USA, 10-14 Sep 1979)	
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32	5:35359	*See* FERMILAB-CONF-79/86-EXP
CONF-791049-	(23. conference on analytical chemistry in energy technology, Gatlinburg, TN, USA, 9-11 Oct 1979)	
27	5:35217	*See* PNL-SA-7740
28	5:35221	*See* UCRL-83402
CONF-7910184-	(IAEA evaluation of solidified high level radioactive waste products workshop, Berlin, F.R. Germany, 15-19 Oct 1979)	
1	5:34601	*See* PNL-SA-8085
CONF-7910187-	(Open workshop on solar technologies, Washington, DC, USA, 23-24 Oct 1979)	
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CONF-791108-	(72. AICHE meeting, San Francisco, CA, USA, 25-29 Nov 1979)	
26	5:34652	NTIS, PC A03/MF A01
CONF-791112-	(Symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 26 Nov 1979,-29 Nov 1979/REPLACES CONF-791173)	
67	5:34591	*See* PNL-SA-7752
68	5:34597	*See* PNL-SA-7734
CONF-7911104-	(DOE/EPRI symposium on Three Mile Island Reactor problems, Harrisburg, PA, USA, 11-29 Nov 1979)	
1	5:34992	*See* PNL-SA-8143
CONF-7911107-	(Energy from waste conference: a decade of development, Toronto, Ontario, Canada, 21-22 Nov 1979)	
1	5:35101	NTIS (US Sales Only), PC A03/MF A01
CONF-7911109-	(Workshop on Government oil spill modeling, Wallops Island, VA, USA, 7-9 Nov 1979)	
(Absts.)	5:34556	Washington, DC; National Oceanic and Atmospheric Administration (1980).
CONF-791204-	(2. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 10-13 Dec 1979)	
40	5:34669	Miami, FL; Hemisphere Publishing Corp. (1979).
CONF-791216-	(Conference on long-term energy resources, Montreal, Canada, 3-4 Dec 1979)	
4	5:34653	NTIS, PC A02/MF A01
CONF-791233-	(Conference on thermal performance of the exterior envelopes of buildings, Orlando, FL, USA, 3-5 Dec 1979)	
9(Rev.)	5:35076	*See* LBL-9653(Rev.)
CONF-791235-	(5. geothermal reservoir engineering workshop, Stanford, CA, USA, 12-14 Dec 1979)	
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CONF-791253-	(Winter meeting of American Society of Agricultural Engineers, New Orleans, LA, USA, 11-14 Dec 1979)	
1	5:34672	St. Joseph, MI; American Society of Agricultural Engineers (1979).
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5	5:35698	*See* ORO-3992-383
CONF-800144-	(Symposia of the Chemical Society no. 14 on diatomic metals and metallic clusters, Manchester, UK, Jan 1980)	

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2	5:34944	*See* HEDL-SA-2034
CONF-800323-	(Symposium on the application of short-term bioassays in the fractionation and analysis of complex environmental mixtures, Williamsburg, VA, USA, 21-24 Mar 1980)	
3	5:35649	*See* UCRL-84593
CONF-800334-	(2. DOE environmental control symposium, Reston, VA, USA, 17-19 Mar 1980)	
22	5:35450	NTIS, PC A02/MF A01
CONF-800383-	(DOD-DOE workshop on joint energy activities, Gaithersburg, MD, USA, 10-12 Mar 1980)	
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8	5:35283	NTIS, PC A02/MF A01
CONF-800460-	(82. annual American Ceramic Society meeting, Chicago, IL, USA, 27-30 Apr 1980)	
6	5:35074	NTIS, PC A02/MF A01
CONF-800482-	(Bio-energy world congress and exposition, Atlanta, GA, USA, 21-24 Apr 1980)	
5	5:34654	NTIS, PC A02/MF A01
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CONF-8004112-	(Intermag conference, Boston, MA, USA, 21-24 Apr 1980)	
1	5:35159	*See* IS-M-283
CONF-800544-	(Electrochemical Society meeting, St Louis, MO, USA, 11-16 May 1980)	
2	5:34633	NTIS, PC A02/MF A01
CONF-800549-	(11. annual modeling and simulation conference, Pittsburgh, PA, USA, 1 May 1980)	
4	5:35653	NTIS, PC A02/MF A01
CONF-800568-	(28. annual conference on mass spectrometry and allied topics, New York, NY, USA, 25-30 May 1980)	
2	5:35216	*See* PNL-SA-8274
CONF-8005103-	(21. AESOP conference, Cincinnatti, OH, USA, 20-22 May 1980)	
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CONF-8005108-	(ASTM symposium on the application of 2 1/4 cr-1 mo steel for thick wall pressure vessels, Denver, CO, USA, 18-23 May 1980)	
1	5:34489	*See* IS-M-282
CONF-8005109-	(International Al-Li conference, Stone Mountain, GA, USA, 19-21 May 1980)	
1(Draft)	5:35149	NTIS, PC A04/MF A01
CONF-800601-	(13. Rochester international conference on environmental toxicity--measurement of risks, Rochester, NY, USA, 2-4 Jun 1980)	
3	5:35540	NTIS, PC A02/MF A01
CONF-800607-	(American Nuclear Society annual meeting, Las Vegas, NV, USA, 8-13 Jun 1980)	
86	5:35821	*See* GA-A-15953
CONF-800609-	(10. international symposium on effects of radiation on materials, Savannah, GA, USA, 3-5 Jun 1980)	
11	5:34920	*See* HEDL-SA-2011-FP
CONF-800616-	(3. world hydrogen energy conference, Tokyo, Japan, 23-26 Jun 1980)	
9	5:34668	Miami, FL; Pergamon Press, Ltd. (1980).
CONF-800617-	(7. international conference on MHD electrical power generation, Cambridge, MA, USA, 16-20 Jun 1980)	
7	5:35057	*See* DOE/NASA/2674-12
CONF-800633-	(7. ocean energy conference, Washington, DC, USA, 2-5 Jun 1980)	
3	5:34710	*See* SERI/TP-631-791
CONF-800648-	(GCFRP program technical review meeting, San Diego, CA, USA, 4-6 Jun 1980)	
18	5:34917	*See* GA-A-15909
19	5:34918	*See* GA-A-15919
CONF-800656-	(Picosecond meeting, Falmouth, MA, USA, 18-20 Jun 1980)	
4	5:35246	*See* LBL-11259
CONF-800680-	(Symposium on health effects investigations of oil shale development, Gatlinburg, TN, USA, 23-24 Jun 1980)	
4	5:35606	NTIS, PC A02/MF A01
CONF-800682-	(35. Northwest 5. biennial Rocky Mountain joint meeting of the American Chemical Society, Salt Lake City, UT, USA, 12-14 Jun 1980)	
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CONF-800688-	(5. European symposium on nucleon-antinucleon interactions, Bressanone, Italy, Jun 1980)	
1	5:35720	*See* BNL-27979
CONF-800699-	(Elliptic problem solvers conference, Santa Fe, NM, USA, 30 Jun-2 Jul 1980)	
4	5:35804	NTIS, PC A03/MF A01
CONF-8006111-	(10. North Eastern regional meeting of the American Chemical Society, Potsdam, NY, USA, 29 Jun-4 Jul 1980)	
1	5:34674	*See* LBL-11232
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1	5:35778	*See* LBL-11252
CONF-8006116-	(Conference on chemistry and physics of coal utilization, Morgantown, WV, USA, 4 Jun 1980)	
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CONF-8006117-	(Workshop on biological carcinogenesis, Detroit, MI, USA, 11-13 Jun 1980)	
1	5:35590	NTIS, PC A02/MF A01
2	5:35612	NTIS, PC A03/MF A01
CONF-8006118-	(28. annual scientific meeting of the radiation research society, New Orleans, LA, USA, 1-5 Jun 1980)	
1	5:35535	*See* LBL-11268
CONF-8006122-	(Conference on Luminescence from macromolecules-biological and synthetics, New York, NY, USA, 16-18 Jun 1980)	
1	5:35479	NTIS, PC A02/MF A01
CONF-800715-	(12. international symposium on rarefied gas dynamics, Charlottesville, VA, USA, 7-11 Jul 1980)	
3	5:35686	*See* MLM-2760(OP)
CONF-800724-	(20. international conference on high energy physics, Madison, WI, USA, 17-23 Jul 1980)	
9	5:35721	*See* SLAC-PUB-2506
17	5:35710	*See* DOE/ER/02232-90
18	5:35694	*See* DOE/ER/02232-89
19	5:35695	*See* DOE/ER/02232-91

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22	5:35708	*See* FERMILAB-CONF-80/75-THY
23	5:35693	*See* BNL-28178
CONF-800731-		(Health Physics Society meeting, Seattle, WA, USA, 20-26 Jul 1980)
3	5:35506	NTIS, PC A02/MF A01
CONF-800740-		(11. international conference on high energy accelerators, Geneva, Switzerland, 7-11 Jul 1980)
14	5:35304	*See* LBL-10755
CONF-800743-		(International conference on nuclear waste transmutation, Austin, TX, USA, 22-24 Jul 1980)
6	5:34938	*See* LA-UR-80-2107
CONF-800744-		(Ion beam modification of materials conference, Albany, NY, USA, 14-18 Jul 1980)
6	5:35171	*See* DOE/ER/03158-91
7(Draft)	5:35148	NTIS, PC A02/MF A01
CONF-800747-		(Review group conference on advanced instrumentation for reactor safety research, Oak Ridge, TN, USA, 29-31 Jul 1980)
6	5:34942	NTIS, PC A03/MF A01
CONF-800762-		(8. international congress on photo-biology, Strasbourg, France, 20-25 Jul 1980)
1	5:35353	*See* BNL-28149
CONF-800763-		(Baryon 80 conference, Toronto, Canada, 14-16 Jul 1980)
1	5:35728	*See* BNL-28198
CONF-800764-		(11. international conference on high energy accelerators, Cern, Switzerland, 10 Jul 1980)
1	5:35290	*See* BNL-28186
CONF-800765-		(7. LLR/MMRD international symposium of interfaces in glass-metal systems, Berkeley, CA, USA, 28 Jul-1 Aug 1980)
1	5:34906	NTIS, PC A02/MF A01
CONF-800766-		(5. international conference on hyperfine interactions, Berlin, F.R. Germany, 21-25 Jul 1980)
1	5:35683	*See* COO-2875-13
CONF-800802-		(89. annual meeting of the American Institute of Chemical Engineers, Portland, OR, USA, 17-20 Aug 1980)
10	5:34979	NTIS, PC A02/MF A01
11	5:34598	NTIS, PC A02/MF A01
13	5:34907	NTIS, PC A03/MF A01
14	5:34940	NTIS, PC A03/MF A01
16	5:34599	*See* HEDL-SA-2064
CONF-800804-		(ASME century 2 emerging technology conference, San Francisco, CA, USA, 10-22 Aug 1980)
21	5:34936	*See* DP-MS-79-78
26	5:34980	NTIS, PC A03/MF A01
CONF-800814-		(180. American Chemical Society meeting/2. chemical congress of the North American Continent, Las Vegas, NV, USA, 24-29 Aug 1980)
16	5:35822	*See* HEDL-SA-2165-FP
CONF-800820-		(American Statistical Society meeting, Houston, TX, USA, 11-14 Aug 1980)
9	5:35362	*See* HEDL-SA-2098-FP
11	5:35538	*See* PNL-SA-8438
CONF-800824-		(5. international symposium on polarization phenomena in nuclear physics, Santa Fe, NM, USA, 11-15 Aug 1980)
19	5:35738	*See* LA-UR-80-2395
21	5:35310	*See* LA-UR-80-2274
CONF-800829-		(International conference on the few body problems, Eugene, OR, USA, 17-23 Aug 1980)
2	5:35687	*See* UCRL-84785
3	5:35689	*See* LA-UR-80-2433
CONF-800842-		(Nuclear EMP meeting, Anaheim, CA, USA, 5-7 Aug 1980)
1	5:35786	*See* UCRL-84437
CONF-800844-		(International conference on polymer compatability and incompatability - prinicples and practices, Midland, MI, USA, 18-22 Aug 1980)
1	5:35195	*See* SAND-80-1914c
CONF-800847-		(International conference on multiple criteria decision making, Newark, DE, USA, 11-15 Aug 1980)
1	5:35045	*See* BNL-28154
CONF-800848-		(3. international conference on composite materials, Paris, France, 26-29 Aug 1980)
2	5:34999	*See* UCRL-84713
CONF-800853-		(Conference on applications of digital image processing to astronomy, Pasadena, CA, USA, 20-22 Aug 1980)
1	5:35672	*See* LA-UR-80-2357
CONF-800855-		(2. international topical meeting on muon spin rotation, Vancouver, BC, Canada, Aug 1980)
1	5:35773	*See* LA-UR-80-2385
CONF-800857-		(Physics in one-dimension conference, Fribourg, Switzerland, 25-29 Aug 1980)
1	5:35783	*See* LA-UR-80-2437
CONF-800859-		(International conference on x-ray processes and inner-shell ionization, Stirling, UK, 25-29 Aug 1980)
1	5:35684	NTIS, PC A02/MF A01
2	5:35677	*See* LBL-11276
3	5:35675	NTIS, PC A02/MF A01
CONF-800863-		(International conference on nuclear physics, Berkeley, CA, USA, 24-30 Aug 1980)
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CONF-800864-		(International conference on physics of transition metals, Leeds, UK, 18-22 Aug 1980)
1	5:35770	NTIS, PC A02/MF A01
CONF-800867-		(Symposium on energy and ecology in the West, Tucson, AZ, USA, 4 Aug 1980)
1(Rev.1)	5:34807	*See* UCRL-83941(Rev.1)
CONF-800901-		(Symposium on intermediate range atmospheric transport processes and technology assessment, Gatlinburg, TN, USA, 29 Sep-2 Oct 1980)
1	5:34901	*See* DP-MS-80-24
CONF-800904-		(American Society of Civil Engineers specialty conference: civil engineering and nuclear power, Knoxville, TN, USA, 15-17 Sep 1980)
1	5:34908	*See* UCRL-84155
2	5:34610	*See* UCRL-84918
CONF-800907-		(Aspects of creep conference, Sheffield, UK, Sep 1980)
2	5:35153	NTIS, PC A02/MF A01
CONF-800908-		(6. international conference on crystal growth, Moscow, USSR, Sep 1980)
2	5:35177	NTIS, PC A02/MF A01
CONF-800916-		(1. international conference on numerical methods for nonlinear problems, Swansea, UK, 2-5 Sep 1980)
1	5:34987	*See* K/CSD/INF-79/22
CONF-800918-		(International solvent extraction conference, Liege, Belgium, 6-12 Sep 1980)
5	5:35229	NTIS, PC A02/MF A01
CONF-800920-		(Geothermal Resource Council annual meeting, Salt Lake City, UT, USA, 9-11 Sep 1980)
27	5:34802	NTIS, PC A02/MF A01
28	5:34769	NTIS, PC A02/MF A01
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3	5:35676	NTIS, PC A02/MF A01
CONF-800928-		(8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface, Cannes, France, 22-26 Sep 1980)
5(Draft)	5:35156	NTIS, PC A02/MF A01
6	5:35178	NTIS, PC A02/MF A01
CONF-800932-		(2. joint Grenoble-Varenna international symposium on heating in toroidal plasmas, Como, Italy, 3-12 Sep 1980)
3	5:35787	NTIS, PC A02/MF A01
CONF-800942-		(ANS topical meeting on 1980 advances in reactor physics and shielding, Sun Valley, ID, USA, 14-17 Sep 1980)
1	5:34913	NTIS, PC A02/MF A01
CONF-800943-		(National topical meeting of fuel cycles for the 80's, Gatlinburg, TN, USA, 29 Sep-2 Oct 1980)
4	5:34590	*See* DP-MS-80-9
CONF-800944-		(7. symposium on microdosimetry, Oxford, UK, 8-12 Sep 1980)
2	5:35760	NTIS, PC A02/MF A01
3	5:35248	NTIS, PC A02/MF A01
4	5:35769	NTIS, PC A02/MF A01
CONF-800946-		(IAEA specialists meeting on gas cooled reactor safety and licensing aspects, Lausanne, Switzerland, 1-5 Sep 1980)

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2	5:34986	*See* GA-A-16033
3	5:34984	*See* GA-A-15920
4	5:34985	*See* GA-A-15926
5	5:34989	*See* LA-UR-80-2481
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2	5:35798	NTIS, PC A02/MF A01
3	5:35819	*See* UCRL-84052
4	5:35810	*See* UCRL-84278
5	5:35812	*See* UCRL-84312
CONF-800952-	(International conference on charged particle optics, Giessen, F.R. Germany, 8-12 Sep 1980)	
1	5:35161	*See* LBL-11393
CONF-800954-	(Ternary superconductors conference, Lake Geneva, WI, USA, 24-26 Sep 1980)	
1	5:35160	*See* IS-M-294
2	5:35781	*See* IS-M-293
3	5:35782	*See* IS-M-295
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1	5:34748	*See* SAND-80-1483C
2	5:34747	*See* SAND-80-1480C
3	5:34750	*See* SAND-80-1541C
4	5:34749	*See* SAND-80-1509C
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1	5:35478	NTIS, PC A02/MF A01
CONF-800964-	(National symposium on the use of cesium-137 to process sludge for further reduction of pathogens, Denver, CO, USA, 3-4 Sep 1980)	
1	5:34616	NTIS, PC A02/MF A01
CONF-800965-	(European conference on optical systems and applications, Utrecht, Netherlands, 23-25 Sep 1980)	
1	5:35271	*See* UCRL-84082
CONF-800969-	(American Concrete Institute fall convention, San Juan, Puerto Rico, 24-25 Sep 1980)	
1	5:35196	NTIS, PC A03/MF A01
CONF-801001-	(International federation for information processing congress, Tokyo, Japan, 6-9 Oct 1980)	
1	5:35843	*See* LBL-9097
2	5:35842	*See* LA-UR-79-3294
3	5:35844	*See* LBL-9538
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1	5:34981	NTIS, PC A03/MF A01
2	5:34982	NTIS, PC A02/MF A01
3	5:34943	*See* HEDL-SA-1825-FP
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1	5:34988	*See* LA-UR-79-3017
CONF-801008-	(43. annual meeting of the American Society for Information Sciences, Anaheim, CA, USA, 5-10 Oct 1980)	
2	5:35859	*See* LBL-10618
CONF-801009-	(6. international conference on very large data bases, Montreal, Canada, 1-3 Oct 1980)	
1	5:35860	*See* SAND-80-0272C
CONF-801012-	(International Federation for Information Processing congress, Melbourne, Australia, 14-17 Oct 1980)	
1	5:35843	*See* LBL-9097
2	5:35842	*See* LA-UR-79-3294
3	5:35844	*See* LBL-9538
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4	5:34725	*See* LA-UR-80-2428
6	5:34724	*See* LA-UR-80-2340
8	5:34723	*See* LA-UR-80-2267
14	5:35073	*See* BNL-28192
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1	5:35855	*See* SAND-80-1051C
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1	5:34814	*See* SAND-80-1581C
CONF-801036-	(Special topical meeting - materials performance in nuclear steam generators, St Petersburg Beach, FL, USA, 6-9 Oct 1980)	
3	5:34919	*See* GEFR-SP-221
CONF-801037-	(American Vacuum Society conference, Detroit, MI, USA, 13-17 Oct 1980)	
3	5:34615	*See* SAND-80-1955C
7	5:35360	*See* BNL-28267
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1	5:34996	*See* SAND-80-1809C
CONF-801048-	(ADPA compatibility meeting, Blacksburg, VA, USA, 13-17 Oct 1980)	
1	5:35370	*See* MLM-2764(OP)
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5	5:35375	*See* SAND-80-0965c
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1	5:34761	*See* SERI/TP-631-841
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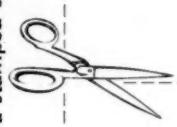

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